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Electro-Nite

Quik-Spec Multi-Lance

Introducing the Quik-Spec Multi-Lance Probe: Your Critical Link to a Fast Converter

Introducing the QuiK-Spec Multi-Lance Probe: Your critical link to a fast converter sample analysis

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Abstract

The Multi-Lance QuiK-Spec probe is a recent and revolutionary development from Heraeus Electro-Nite with one main purpose: to provide a fast and reliable analysis of the most critical elements such as Carbon, Phosphorus, and Manganese in two minutes after its immersion during converter treatment.

The important reduction in analysis time has been achieved by providing a new type of sample, with no preparation needed and ready for a direct spark. This sample is analyzed by the QuiK-Lab, a dedicated spectroanalyzer designed for the challenging environment near the converter.

The introduction of this new revolutionary technique does not however affect standard converter practice, as the existing sublance technology is used with some minor modifications to the hardware. The new hardware for these QuiK-Spec probes can also be used for the existing TSC-TSO probes; the operator just selects the correct probe for the job.

Temperature, oxygen, and liquidus measurements are still based on the existing Heraeus Electro-Nite technology, as used by the Multi-Lance probes.

This paper will discuss the results obtained, as well time performance, analytical performance, and success rates of the new QuiK-Spec Multi- Lances.

1. The QuiK-Spec Multi-Lance: an innovative approach to sampling

One of the priorities of the QuiK-Spec development was to provide a Multi-Lance probe that would cope with the existing Multi-Lance functions (temperature, liquidus…) whilst also providing a sample that would give an analysis within two minutes after the Multi-Lance measurement.

These requirements could only be met if:

- the need for grinding or milling of the sample was completely removed
- the sample was cold enough to ensure a correct analysis, and
- an independent spectroanalyzer was installed close to the converter to avoid transport time.

1.1 A new type of probe

A clean surface and low sample temperature could only be possible by modifying the sample design. The existing Multi-Lance sample cannot be used for such purposes. The QuiK-Spec sample is therefore quite different to the conventional Multi-Lance lollipop sample, as shown in the enclosed **picture:** the sample thickness does not exceed 2mm.

This new design allows its most innovative feature: the preparation-free surface. Moreover, the sample surface is below 200°C when it is removed from the Multi-Lance, ensuring a correct analysis using the QuiK-Lab.

1.2 A different sampling procedure

The QuiK-Spec probe has its own sampling procedure. The filling of a lollipop sample is mainly determined by the melting and opening of the slag cap. The sample in the QuiK-Spec probe is filled at a very specific point during the measurement.

The sample is filled by the controlled use of gas purging technology, using either nitrogen or argon. Purging takes place as the lance descends, which prevents slag inclusions getting into the sample. Purging stops when the lance is at its lowest level. The sample is then filled, resulting in a sample with a preparation-free surface and free of slag inclusions. Figure 4 shows the exact time of sampling.

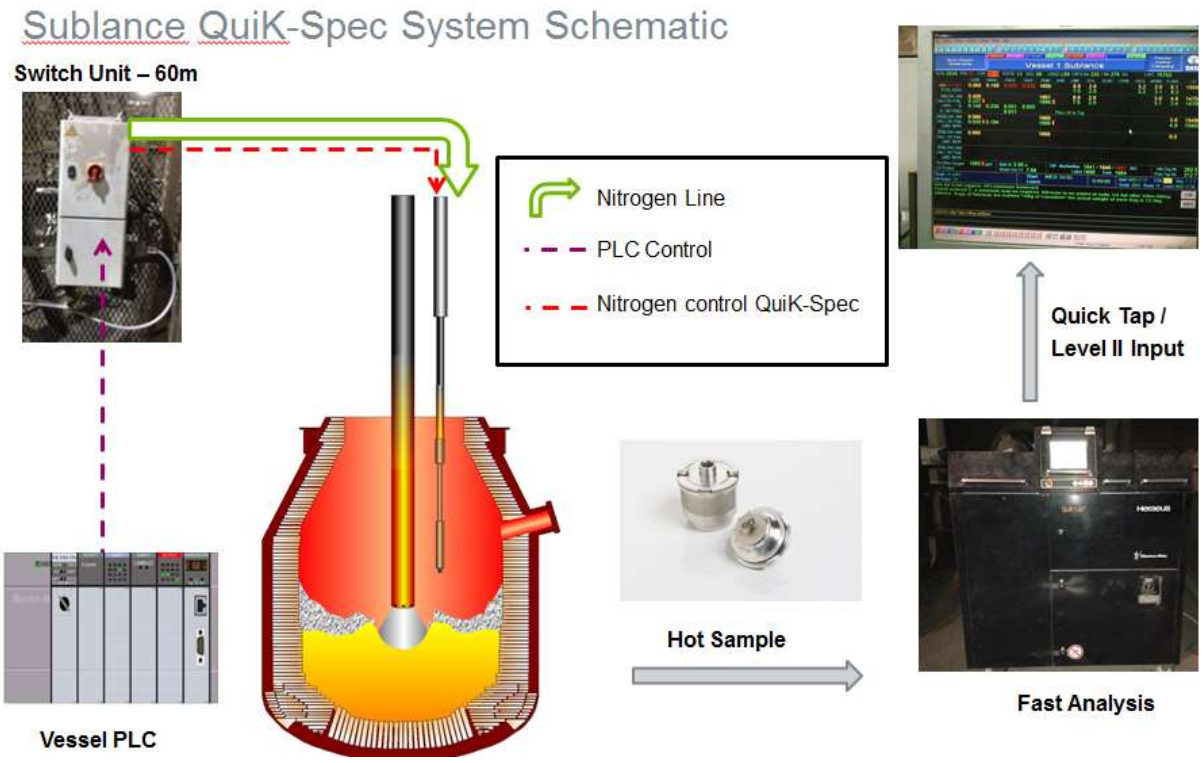
1.3 Modified hardware: The QuiK-Spec System

Some hardware changes are required to support this new sampling technique. Figure 4 outlines the steps needed to implement the QuiK-Spec.

An additional pneumatic control unit called the QuiK-Spec Switch unit is installed near the sublance system and controls the flow of the nitrogen and the sampling sequence during the measurement. This control unit joins up with the existing wiring of the Multi-Lance system. Inside the sublance itself, a hybrid cable is used, which combines electrical wiring and pneumatic tubing.

This internal hybrid cable is connected to a new probe holder, which incorporates electrical and pneumatic functions and uses a small valve to regulate the flow and filling of the sample.

Both the internal and loop cable are completely compatible with the conventional Multi-Lance probes.



2. A different analytical approach: The QuiK-Lab

The QuiK-Spec Multi-Lance provides a preparation-free sample. This means that important time is saved by the removal of the grinding or milling step. Even more time can be saved by an operator carrying out the optical emission spectroscopy analysis at a location near the converter, which removes the transport time of the sample to the lab.

This is done by using the QuiK-Lab cabinet. The core function of the QuiK-Lab is to analyze the QuiK-Spec sample and ensure the direct exploitation of its results by the convertor shop.

The QuiK-Lab spectroanalyzer provides:

- A strong enclosure suitable for the convertor
- A balance between operational simplicity and accurate analysis
- Automatic sample calibration based on preloaded reference samples

The QuiK-Lab has been designed and developed to withstand the harsh environment around the converter, whilst access to the unit and its analyzing functions is easy and ensures a fast analysis. The instrument requires minimal maintenance.

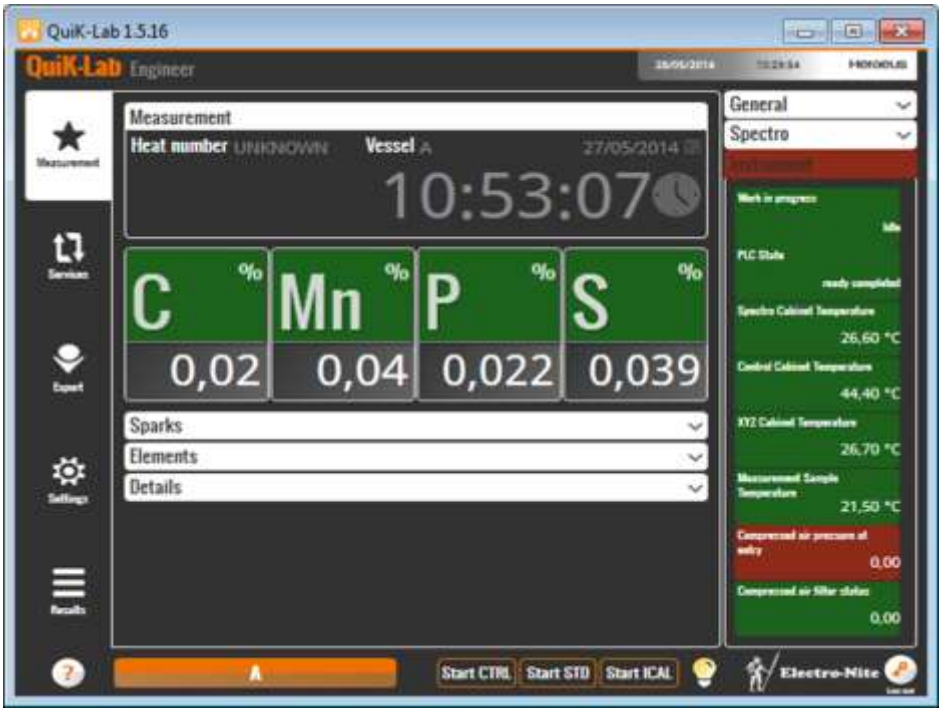
2.1 The analysis: combining speed, simplicity, and accuracy

The Multi-Lance enables the sample to be demoulded quickly. The operator puts the sample in the sample holder in the QuiK-Lab. A positioning robot takes over and moves the sample to the first measurement position, a spark is ignited, and a result obtained in 20 seconds.

By default, the following critical elements are analyzed and displayed :

- Carbon
- Manganese
- Phosphorus
- Sulphur

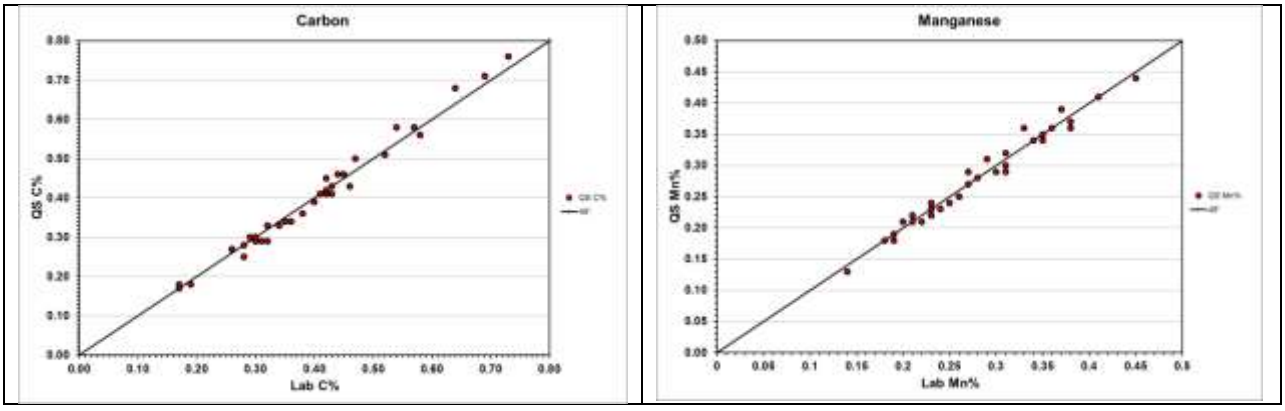
A total of 21 other elements are also analyzed and displayed and send to the steelplant database. The following picture shows an example of a measurement display:

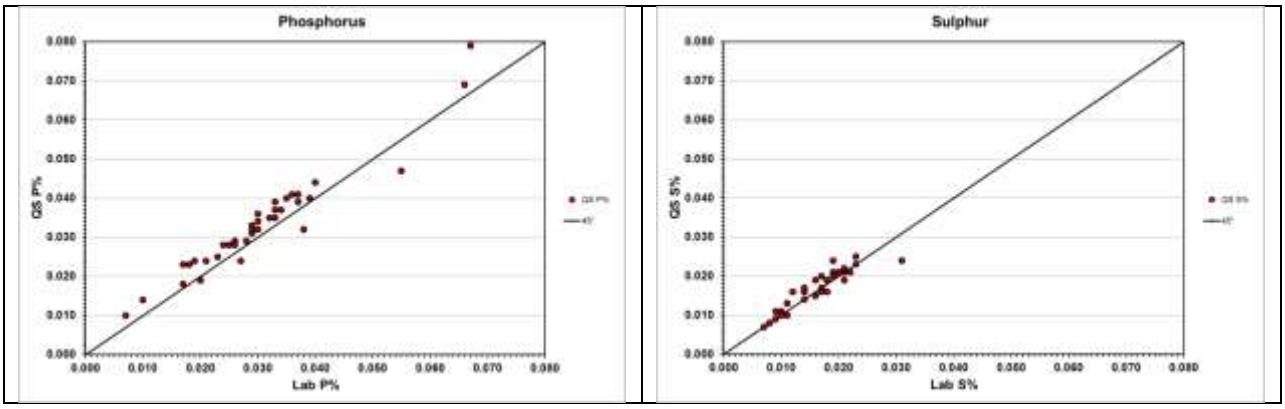


2.2 Analytical results

Steel plant operators can make crucial, in-process decisions based on the analysis obtained from the QuiK-Spec probe and the QuiK-Lab spectroanalyzer. But does the reduction of the analysis time mean a reduction in the quality of the analysis?

The enclosed figures show the results of the QuiK-Spec samples analyzed on the QuiK-Lab and the results of the same QuiK-Spec samples analyzed on the conventional OES-analyzers in the lab. These results are collected over a period longer than a week shows the stability of the QuiK-Spec probes and QuiK-Lab analyzer. These results clearly show that the QuiK-Spec provides a correct and reliable analysis for the TSC probe.





2.3 Analysis time

Other crucial factor is the time lag between the measurement in the converter and the availability of the analytical results to the operator. This is determined by the time needed:

- for the sublance system to travel from the measuring position to the probe dropping position
- to strip the sample from the probe
- for the QuiK-Lab to provide the analysis.

The sublance travelling time differs from plant to plant. The time required for stripping the sample, analyzing it, and displaying it on the operator's monitor takes on average not more than a minute. Assuming that the QuiK-Spec needs another minute from the converter to the dropping bay, the total measurement time can be reduced to two minutes, about half of the time needed in conventional sublance practice.

2.4 Quik-Lab Maintenance

Operating the QuiK-Lab is easy. The convertor operator's input is reduced to basic, standard handling. The steel plant's input is reduced to a minimum involvement in an automated calibration procedure. On request, the QuiK-Lab runs an automatic calibration using a set of reference samples. This ensures the QuiK-Spec remains reliable and available 24/7. A weekly calibration is carried out to guarantee long-term stability using another set of calibration samples.

Figure 6 shows the QuiK-Lab calibration set. The samples need regular, minor maintenance, such as a simple grinding step.

Conclusions: The industrial experiences/Steps ahead

The QuiK-Spec has been in use for longer periods in converter shops at TATA Scunthorpe and Arcelor Mittal Vanderbijlpark. The results prove its reliability and feasibility. The success rate of the samples is comparable to the samples obtained with the conventional Multi-Lance probes. The ability to use the conventional Multi-Lance probes on the newly developed hardware gives the converter shop flexibility in their process. The experiences have been positive and have urged Heraeus Electro-Nite onwards in its quest to provide measurements using the sublance system within the shortest time possible. Further research is underway to provide TSO measurements, where the analytical requirements demand an accuracy of a higher level.