



Quantifying detergent active agents in-line

Detergents manufacturing processes require a precise balance between the different ingredients of the blend, but how can you monitor this non-destructively in real time?

An industry based on complex blends

Liquid detergents are complex blends of different sub-products (detergents, enzymes, fragrances, chelating agents, etc.). Some, like the enzymes, are present at very low concentrations but have a significant impact on the effectiveness of the end-product.

In addition, because production is continuous, with formulation changes every two hours, multiple operations are usually necessary to check the products.

The right balance between the different ingredients must therefore be quantified precisely in real time to guarantee the quality of the end-product and optimize the efficiency of the production facilities.



The advantage of checking in situ

The purpose of this study was to develop and validate a quick, non-destructive method for determining and quantifying the chemical composition of 6 liquid detergents, some at concentrations of less than 1%.

The goal will then be to implement this quantification in-line and apply it in real time to replace the manual measurements which waste 30 minutes for each check (between 8 and 20 checks per day).

How?

Our Viserion Raman solution was used in combination with multi-variable modeling according to a 3-phase development process:

- A phase to examine the feasibility and calibration of the model on a small scale using the Vial Analyzer at-line measuring tool
- A pilot transfer phase to validate the operation of the quantification models in real-life conditions
- A phase for industrial rollout on the production site, using OPC-UA to communicate with the PLCs

Development and validation of a quantitative model

The Raman system provided highly informative spectra in just a few seconds. The use of algorithms such as PLS made it possible to generate precise quantification models in the laboratory, on the pilot line and in production.

Figure 1 shows the spectra and Figure 2 shows the performance of the model. These mathematical models have been integrated in a suitable format directly on the analyzer. The in-line analysis results are then communicated directly to the PLCs via OPC UA.

Our solution thus saved 3 hours' production time per day, while also providing 100% verification.

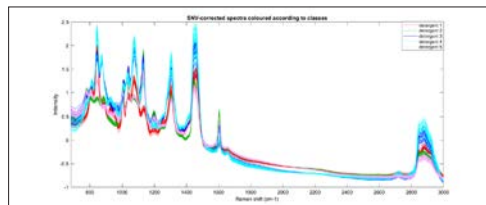


Figure 1: Spectra of the different formulations

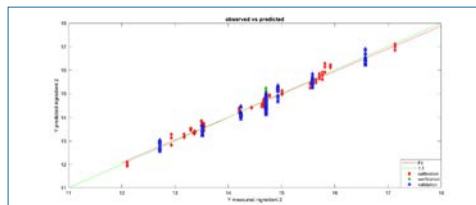


Figure 2: Quantification model for the precursor agent

	recovery	stdev
Calibration set	100,02%	1,25%
Validation set	99,65%	1,48%
Verification set	100,91%	1,42%

Viserion's numerous accessories made this project a success.

The Vial Analyzer can be used to measure the samples in the laboratory with the same optical distance as an integrated at-line probe (Figure 3), while the clamp-format immersion fittings with laser interlock allow safe, effective measurement on the line (Figure 4).



Figure 3: Laboratory measurement fittings



Figure 4: Integration of the Raman system

Advantages of Viserion

Our Viserion system proposes a flexible solution, from the laboratory to operational in-line implementation:

- A set of tools for measuring media at-line through various containers (vials, plastic, etc.),
- Raman spectroscopy backed by chemometrics allowing precise quantification of several products of interest in complex blends,
- A tool and a communication system enabling application of the models developed for in-line monitoring,

Viserion can be used to develop and refine a quantitative model in a complex medium and then apply it in-line in real time.



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