

## Application Note: Enzyme Level Monitoring in Laundry Detergent

### Introduction

Enzymes are key components for the cleaning action of laundry detergents. They break down stains on clothing, thereby making cleaning quicker and easier. As a result, an important part of quality control in detergent manufacturing is ensuring that the enzyme levels are consistent.

An automated method for on-line monitoring of enzyme levels eliminates manual QC measurements, and thus furthers the concept of Touch Reduction in detergent manufacturing processes.

### Principle

The FIA Lab fluidic analyzer draws an aliquot of the detergent product through a sampling path specifically designed for viscous solutions. (Most detergents are thick-flowing and a specialized sampling arrangement is required in order to draw a sample in a precise manner.)

The detergent sample is then diluted in a two-stage process. Extensive dilution is necessary since most detergent products contain enzymes at levels that would exceed the range of enzyme indicator reagents. Dilution also makes it easier to mix the sample with the indicator reagent in a precise and reproducible manner.

The diluted sample is mixed with a reagent solution containing an enzyme substrate conjugated with a (quenched) chromophore. When the enzyme acts on the substrate, it cleaves the bond between the substrate and the chromophore. The liberated ("unquenched") chromophore absorbs light and can be used to quantify enzymatic activity in the mixture.

**ENZYME**

**Abs. @ 405 nm**

**SUBSTRATE-TAG → SUBSTRATE + TAG**

The measurement is made in stopped-flow conditions across a period of several minutes. This helps eliminate background effects (such as native color or refractive index) and increases measurement sensitivity.

### Application benefits

- |                     |   |                               |
|---------------------|---|-------------------------------|
| Automation          | → | Reduced manual labor          |
|                     | → | Touch reduction               |
| Real-time operation | → | Immediate result availability |

## Experimental

### Enzyme Assay

#### Protease

### Reagent Composition

Diluent: Water

Indicator: N-Succinyl-Ala-Ala-Pro-Phe p-nitroanilide (PNA)

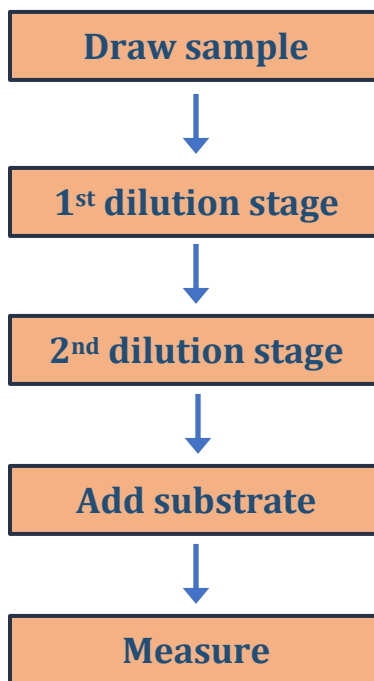
### Instrument Configuration

Analyzer: FIALab Process Analyzer, equipped with sampling  
samples

module for viscous

Detection: 405 nm, stopped flow conditions

### Measurement Sequence



## Results

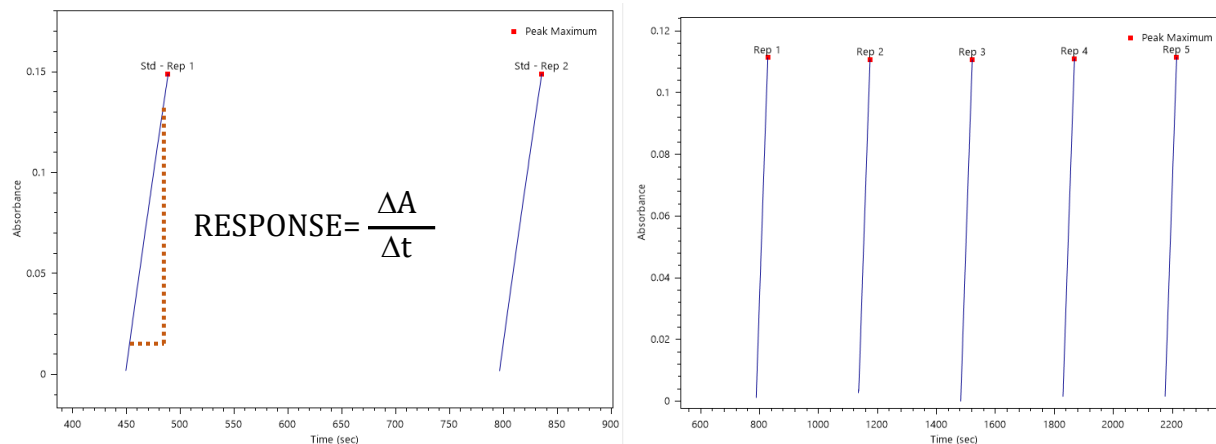


Figure 1 Left: quantification of protease activity response, determined as the slope of the absorbance signal. Right: five replicate measurements (RSD 0.8%).

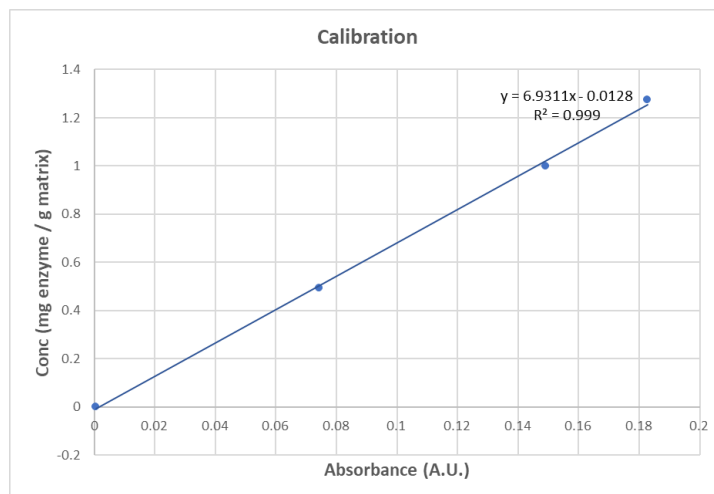


Figure 2 Calibration curve for protease assay.

## Conclusions

The FIA Lab fluidic analyzer, configured for the protease method, is capable of successful and reliable quantification of protease levels in liquid detergents. The setup overcomes the following obstacles typically encountered with alternative measurement technologies:

- Precise sampling of thick-flowing liquids.
- Programmable and reproducible dilution of the thick detergent sample with water, up to a combined dilution factor of 1000.
- Precise and complete mixing of the diluted sample with the indicator reagent.