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Abbey the Koningshoeven has won many prizes regarding the sustainability of their WWTP. The Koningshoeven wants to decrease their environmental footprint by replacing the chemical "reference" test for COD (Chemical Oxygen Demand) with an environmental friendly alternative.

microLAN offers the STAC, an Aqualabo instrument, to replace the reference test, in this case the Hach Lange cuvette tests. The STAC is a spectral analyser which measures spectral absorption in the 203-321nm wavelength range with a bandwidth of 12nm. To enable the STAC to measure COD, the STAC needs to be calibrated. The calibration is done by creating a model with the use of Aqualabo UV PRO software.

The objective of this study is to create a model for the EQ 1 (influent) of the brewery and the MU (municipal wastewater) of the visitor centre.

To calibrate the STAC to measure COD, 41 absorption spectra are acquired with the use of the Pastel UV from Aqualabo, which is a portable version of the STAC. The 41 spectra are attached to 41 reference test values, in this case the reference tests are the Hach Lange LCK 014 (100-2000 COD mg/L) & LCK514 (1000-10000 COD mg/L). The samples were taken from 30 September to 30 October 2019. The samples are taken at different time periods to ensure a widespread amount of absorption spectra and their corresponding quick test values. For example, samples are drawn during the production of different beers, when rinsing is taking place, cleaning etc. A schematic overview of the WWTP, measuring and monitoring process is shown in figure 1.
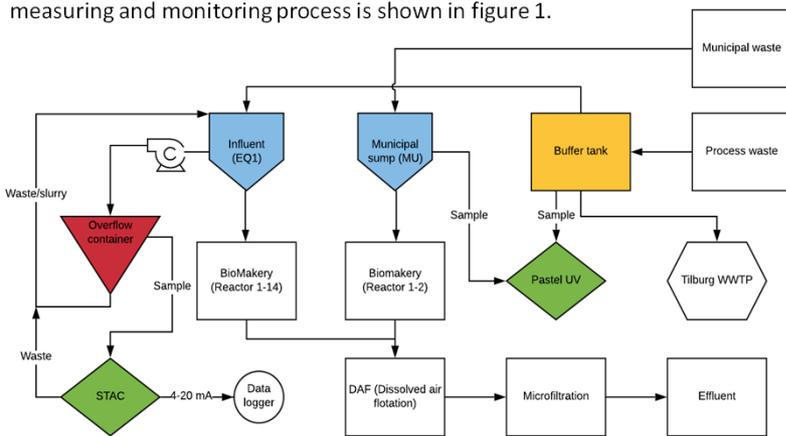

Figure 1. Schematic flowchart of the Koningshoeven WWTP, including measuring setup. In green where the STAC and Pastel UV samples are taken.

Through the use of a PLS regression analysis UV PRO software is able to create a model for the MU and EQ 1 enabling the models to calculate COD of a sample with the use of 5 reference spectra. The reference spectra are the output of the PLS regression analysis. The calculated models are shown in figure 2 & 3.
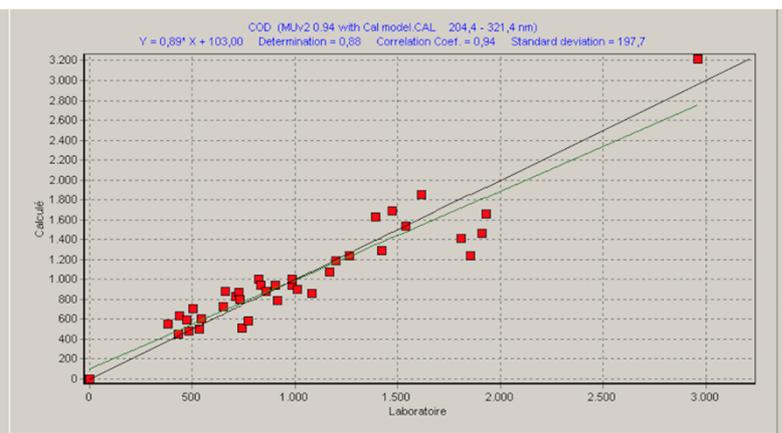

Figure 2. Calculated linear PLS regression for the MU. Determination = R². RSD = 19%.

Figure 3. Calculated linear PLS regression for the EQ 1. Determination = R² RSD = 16%.

UV PRO software provides a calculation to assure the model is able to give a valid value to an absorption spectra, this is done by creating a spectra out of the 5 reference spectra, called the "restitution spectrum", an example is shown in figure 4.
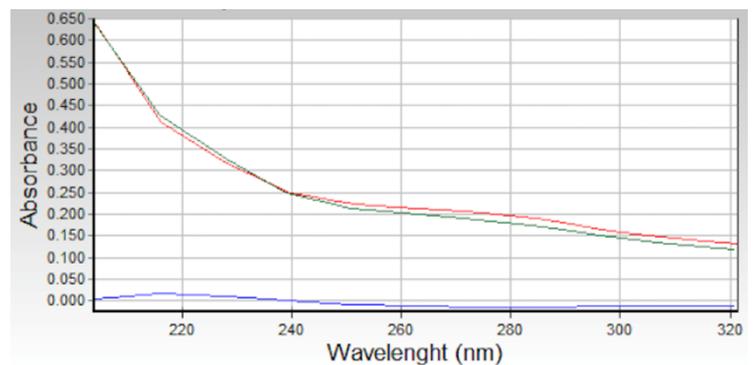

Figure 4. Example of a measured spectra that is restituted by the model, the restitution gap indicates the difference between measured and restituted spectrum.

Red line = Measured spectrum
Green line = Restituted spectrum
Blue line = Difference measured spectrum & restituted spectrum (%)

The results show that the MU and EQ 1 models are able to represent the measured Hach Lange quick COD test values quite accurately, according to the R^2 of the models being 0,88 and 0,85 respectively . With the MU having a range of 0-2000 COD and the EQ 1 a range of 2000-8000 COD.

Pros:
- No errors due to sampling, sample transport, human error and storage.
- Constant monitoring provides a continuous data stream compared to grab samples that provide only snapshots of the water composition on a limited number of points in time.
- No reagents, thus no toxic chemical waste compared to the cuvette tests. Only a supply of distilled water and cleaning solution are needed.
- Automated measurements (2 minutes), on site and the ability to detect rapid changes and automatic dilution
- Multiple samples possible so one can like at different supply streams.

Cons:
- No 100% accurate measurements, RSD of 19% (MU) and 16% (EQ1).

It is recommended to use the STAC to get a continuous monitoring of COD in different supply lines of the treatment and replace the reference tests.