

ImPACts

Industrial Methods for Process Analytical Chemistry - From Measurement Technologies to Information Systems

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: K-Projects

COMET subproject, duration and type of project:
imPACts, 09/2014 – 08/2018, multi-firm

Beer quality is going non-linear

During the production process of beer, it is of utmost importance to guarantee a high consistency of the beer quality to assure a smooth taste. Manual supervision of essential quality parameters is time-intensive and costly: duration times of about four hours for 10 samples. During a joint collaboration between BrauUnion, RECENDT and FLLL, accurate quantification of the most essential parameters in unfermented beer („bitter value“) and Radler („citric acid“) could be established fully automatically with the combination of NIR spectroscopy and specific non-linear mathematics.



The analytical challenge

Everybody who is loving to have a glass of beer now and then will agree, that already very little changes in the taste are recognized and are disturbing. Analytical techniques for quality control in beer production are very important for taste assurance. The gathering of analytical measurements in the laboratories of breweries is time-consuming for operators and costly for the companies. This is because samples have to be taken manually to be processed in different specialized instruments. Today, the analysis of 10 samples for the most relevant parameters in unfermented beer („wort“), namely bitterness, final attenuation (FA) and free amino nitrogen (FAN) requires operator's efforts of about four hours and a time duration of about 24 hours in sum. A similar situation is given in case of Radler for the analysis of bitterness, citric acid, sum of the acids and froth.

The analysis of these parameters is indispensable, as they are most responsible for a consistent and smooth taste of the beer/Radler the

regular customer is already used to. Violations of allowed values would lead to a different, unexpected taste (e.g. a too high bitterness of a certain brand of beer) and may rise customer complaints, causing significant costs and the risk of losing reputation.



Make things easier!

In a cooperation within the K-Project imPACts, RECENDT - researchers tried to utilize a technique called Fourier transform mid-infrared (FT-MIR) spectroscopy to measure those parameters. The great benefit was, that this technology does not need any preparation of the samples and it can give results practically in real time. The drawback was, that with standard procedures it was not possible to achieve measurements in the needed high quality and reliability!

But the setting of the cooperative project as it was given in the K-Project imPACts lead to a solution: what could not be solved in a completely satisfying way by the laboratory-experts at

Brau Union, by physicists and measurement technologists was tackled by mathematicians – and it could finally be solved together!

The key to success lies in the usage of non-linear multivariate calibration techniques from the field of machine learning.



Beer production going non-linear – but not only in terms of geometry: non-linear mathematical methods make analytics more efficient. (© Brau Union Österreich AG)

In particular, RECENDT-researchers set up sophisticated FT-MIR - measurement routines. And FLLL-researchers applied extensions of support vector regression (SVR), a widely used and accepted method for establishing high accurate models from data. These have been

investigated to overcome high computation times in high-dimensional problems (caused by many influencing wavelength/bands in the spectra) by substituting the original samples with their projection onto the subspace, and to overcome time-intensive and inappropriate settings of learning parameters.

In other words: Brau Union and RECENDT gave the raw measurements – and FLLL gave it the smart brains!



Impact and effects

The developed measurement system performs the measurement with high quality, accuracy and reliability – and saves time and operators' efforts for other non-routine tasks.

It helps to ensure optimum beer quality in a much better way than the traditional measurement, as the results are available much faster: 2 minutes instead of 24 hours.

And as there are practically no user-interactions, the new system also prevents any operation errors.

All in all, it brings Brau Union one step closer to their vision of a Brewery-Laboratory 2020. And it brings top-quality beer and Radler to all who love it.

Contact and information

K-Project imPACts

RECENDT – Research Center for Non Destructive Testing
 Altenberger Straße 69, 4040 Linz
 T 0732 / 2468 - 4602

E robert.holzer@recendt.at www.k-pac.at www.recendt.at

Project coordinator

Robert Holzer

Project partners

Organisation	Country
Brau Union Österreich AG	Austria
JKU Linz - Fuzzy Logic Laboratory Linz-Hagenberg	Austria
OMV Refining & Marketing GmbH	Austria
Lenzing AG	Austria
Sandoz GmbH	Austria

Further information on COMET – Competence Centers for Excellent Technologies: www.ffg.at/comet

This success story was provided by the consortium leader/centre management for the purpose of being published on the FFG website. FFG does not take responsibility for the accuracy, completeness and the currentness of the information stated.