

Moving Towards a Greener Future

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On 20 & 21 June 2022, stakeholders from the cleaning & hygiene industries met in Constance for the annual conference of the SEPAWA® Professional Cleaning and Care Specialist Group.

This is aimed at manufacturers and users of professional products and has been providing information on current developments in this field for more than fifteen years. The event with the title *“Back to the future. It’s going green again - digital and ecological cleaning”* was presented by Prof. Dr.-Ing. T. Kimmel. Out of the total of ten expert lectures, five lectures on the first day addressed the topics of environment and raw materials. (1) Prof. Dr. Bach from MCI Innsbruck showed how waxes can be obtained as a by-product from apples, (2) Dr. Zibek and Dr. Müller from Allianz Biotenside gave an overview of the production of raw materials by fermentation and (3) Prof. Dr. Schomäcker from the Technical University of Berlin introduced a new class of surfactants that contain CO₂ as a building block. (4) Dr. Tropsch from BASF gave an overview of the ecological profile of typical “green” surfactants on the market and (5) Mr. Kreische from the company Dr. Schnell presented how one can calculate the CO₂ footprint of formulations by oneself.

There were three different topics on the second day. First, (6) Mr. Bantelmann from Dr. Brill + Partner presented innovations in the area of biocides regarding the biocide regulation at EU level, and (7) Dr. Schöbel from MCI Innsbruck

presented the use of UV light with the help of LEDs. In the area of digital innovations, an app for organising cleaning was presented by (8) Mr. Lechner from hollu Systemhygiene and the current status of autonomous cleaning in households and businesses was presented by (9) Niederrhein University of Applied Sciences. The conference was concluded by (10) Ms. Malocho from Institut Fresenius with a comparison of the cleaning effect of professional cleaners and products for the household.

1. Prof. Dr. Katrin Bach (Management Center Innsbruck)

As part of the funded APPOVAL project, Prof. Dr. Katrin Bach’s research group at the Management Center Innsbruck tested single-variety apple pomace (press residues from apple juice production) for various usable ingredients. Pectins, waxes and antioxidants were of particular interest, as they could be used as regional raw materials for cleaning and care products as well as cosmetics. Prof. Bach reported in her lecture on the extraction methods used, such as the classical Soxhlet method and CO₂ extraction, the yields achieved of pure apple waxes and polyphenols as antioxidants, as well as on the comparison of data from two different harvest

years with regard to the influences of temperature, precipitation and sunny days on the apple pomace. Both qualitative and quantitative differences were found.

The apple waxes obtained were used to produce aqueous emulsions, which are also used as floor care products in the floor polish sector.

First results of the characterising tests of such wax coatings were very promising, but had to be limited to the essentials due to the small sample quantities available.



Fig.1 First application tests of the wax emulsions for the care of oak surfaces in direct comparison to conventional formulations containing carnauba wax. © hollu Systemhygiene GmbH (Research & Development Department)

2. Dr. Zibek and Dr. Müller (Biosurfactants Alliance)

In a tandem lecture, Dr. Zibek from the Fraunhofer Institute for Interfacial Engineering and Biotechnology and Dr. Müller, Head of R&D Basics and Raw Materials at the Dalli Group, presented the work of the Biosurfactants Alliance. This consortium of potential biosurfactant manufacturers and users is researching the microbially produced surfactants of tomorrow. In addition to the already known glyco- sophoro- and rhamnolipids, the production of other surfactants, such as mannosylerythritol lipid (MEL) or cellobioselipids (CL), is being investigated with the help of microorganisms. The researchers are working exclusively with renewable raw materials, preferably obtained from previously unused value chains - for example, sugar residues (beet pulp), domestic vegetable oils (rapeseed oil, sunflower oil, used cooking oil) but also insect fats; an example of this is the larva of the black soldier fly - a species already bred as a protein source, which is rich in lauric acid and thus similar to the composition of coconut and palm kernel oil. In bioreactors fumigated with air, the investigated microorganisms such as bacteria and fungi or also enzymes produce the corresponding surfactant variants from these sugars or oils. In addition to the optimisation/up-scaling of the production, the technical application side is being investigated in parallel: In addition to the typical surfactant parameters such as CMC, contact angle, surface tension, foaming behaviour and HLB value, practical trials have already been carried out in industrial cleaners and rinse aids. The results are promising: the profile of MEL corresponds to that of a hydrophobic and efficient conventional non-ionic surfactant.

3. Prof. Dr. Schomäcker (TU-Berlin)

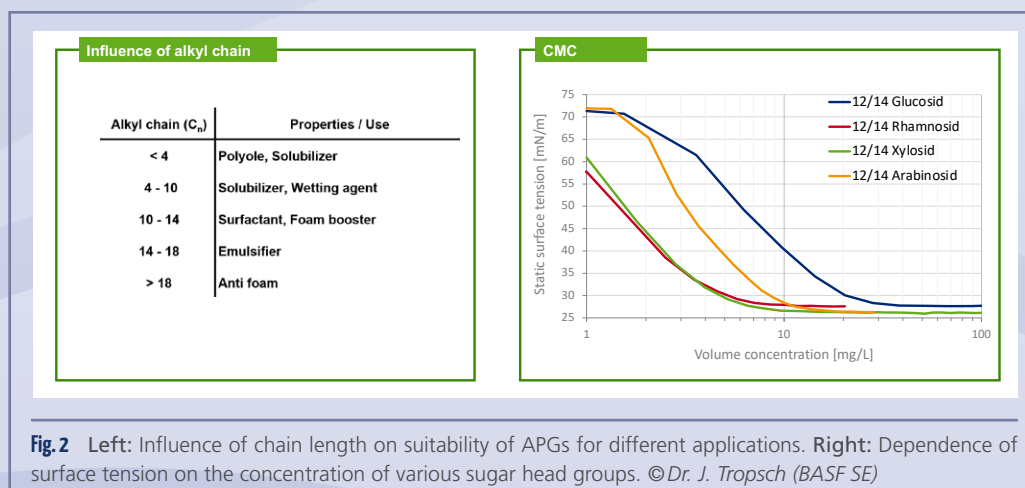
Prof. Dr. Schomäcker from the TU-Berlin presented results on the incorporation of CO₂ into surfactant molecules. The work is embedded in a long-running BMBF-funded joint project between universities and industrial partners. The idea is to use CO₂ from combustion processes as a raw material for the production of non-ionic surfactants. Non-ionic surfactants are often used as a formulation component, e.g. in detergents or cleaning agents. As a surfactant, the molecule consists of a fat-loving part, usually a fatty alcohol, and a water-loving part, which often contains e.g. several ethoxy groups (-O-C₂H₄-). These products are widely used as fatty alcohol ethoxylates. In the case of CO₂-containing surfactants, individual ethoxy groups in the molecule are replaced

by CO₂. Despite the replacement, it is hoped to obtain surfactants with similarly good application properties as the conventional surfactants and in this way to be able to improve the environmental balance of cleaning products. The newly synthesised surfactants were characterised on the basis of physical properties such as the hydrophilic-lipophilic balance (HLB value) as well as the surface tension of the diluted cleaning solution and the critical micelle formation concentration (cmc). The results indicate that the properties are basically comparable to those of conventional surfactants without CO₂ and therefore nothing should stand in the way of their use in the field of cleaning in the future.

4. Dr. Jürgen Tropsch (BASF SE)

Dr. Jürgen Tropsch gave an overview of the possibilities and limitations of green surfactants. After soap had established itself as a detergent and cleaning agent in the early 20th century, further milestones in the industry followed with synthetic molecules such as linear alkylbenzene sulphonate (LAS) and novel, renewable and biodegradable detergent substances. Alkyl polyglycosides (APGs) were presented as examples of green surfactants already established in the market. These are produced from cane sugar and palm kernel oil/coconut oil, have good ecological and toxicological properties and are thus suitable for cleaning as well as cosmetic applications. The biggest advantage of APGs is their variable formulation function. Thus, the properties of the surfactant can be influenced by specific selection of the alkyl chain length (C_n) or the sugar head group.

Using data from the Association of the Oilseed Processing Industry in Germany (OVID), the negative image of palm oil was put into perspective. Almost 40 % of the total output of vegetable oil production can be attributed to palm oil, while only 8 % of the land used is taken up for this purpose. Thus, palm oil and palm kernel oil are produced more efficiently than all other vegetable oils. Finally, Dr. Tropsch held out the prospect of system solutions with an integrated recycling cycle for chemical components as the green standard of the future.



5. Robert Kreische (Dr. Schnell)

Robert Kreische, deputy laboratory manager of the company Dr. Schnell from Munich, showed in his presentation how a medium-sized company can prepare CO₂ balances of all sales products (PCF) without the help of external companies, which are often expensive and inflexible, and also successfully certify them according to ISO 14067 "Carbon footprint of products - Requirements and guidelines for quantification". For the creation of the PCFs, the CO₂ balancing of all approx. 500 chemical raw materials used and all approx. 2000 containers and labels was carried out. As the data basis on the part of the manufacturers is not (yet) very well developed, databases such as Ecoinvent/GEMIS and studies were used. The complete life cycle, cradle to grave, was taken into account in the calculation. The calculation and documentation according to ISO 14067 was realised with the help of a self-developed Access database, which retrieves the current data directly from the databases; the implementation in the recipe management software of R&D as well as in the ERP software followed. In this way, the CO₂ balance of each article can be created automatically, and alternative raw materials can be analysed for their actual impact on the environment with a click of the mouse, without the need for a time-consuming LCA study each time.

The project implementation was completed in 11 months and an annual savings potential of 1.5 million kg CO₂ was uncovered ad-hoc.

6. Christoph Bantelmann (Dr. Brill + Partner)

The presentation by Mr. Christoph Bantelmann dealt with innovations in the standard tests for proof of efficacy against various target organisms, which will be required in future for biocide approval procedures. An important overview standard is EN 14485, which regulates which proofs of efficacy must be provided for certain areas. A new version with amendments is expected before the end of 2022.

There will also be innovations in the practical tests for phase 2 and stage 2 according to EN 16615. For example, in addition to general adaptations such as the test specimen material, new: FOREX, and drying, in future fungicidal, tuberculocidal and mycobactericidal proofs of efficacy will also be tested with the "4-field test" (standard from 2022/23). A prEN 17846 for the performance of a sporidial "4-field test" and a "4-field test" with regard to virucidal efficacy are also in progress (standard expected from 2023/24).

To prove the virucidal efficacy of hand disinfectants, in future there will also be test person trials based on EN 1500 with viruses: prEN 17430, in which the efficacy criterion is defined as "non-inferiority" compared to a reference product with 70% (v/v) ethanol (standard from 2023).

A revision of the test standard for chemo-thermal laundry disinfection is planned, which will involve corrections. However, no "relevant" technical changes are expected (standard from 2022).

In addition, Mr. Bantelmann gave further interesting perspectives on discussed and possible adaptations of test standards in various areas, such as specially adapted "4-field tests" for household and industrial areas (standard from 2023?), long-term effects of surface disinfectants and laundry processing in the household (pr17658 from 2022) and room disinfection (EN 17272).

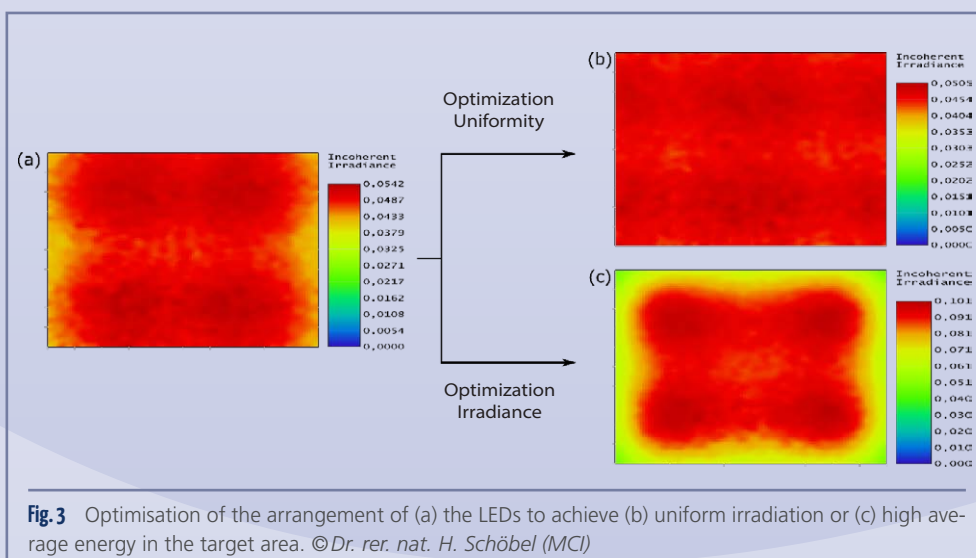
7. Dr. Schöbel (MCI, Innsbruck)

In his lecture on disinfection with UV-C LED light in theory and practice, physicist Dr. Schöbel from MCI in Innsbruck first presented the inactivation kinetics of microorganisms by UV-C based on his own investigations. For this purpose, various LEDs were available that can generate UV-C radiation with wavelengths in the range of 255 to 285 nm - visible light, by comparison, is in the range of 400 to 700 nm.

At low radiation doses below 5 mJ/cm², the focus is on rapid deactivation in bacteria due to DNA damage. At higher radiation doses, the microorganisms are further deactivated, as expected, but no longer as effectively as in the initial range. This is presumably due to the fact that it is mainly proteins that are damaged by free radicals.

In the case of the self-manufactured LED set-ups, the positioning of the LED is important in order to achieve either uniform irradiation or high irradiance in the target area. For this purpose, the path of the radiation can be optimised by ray tracing.

The disinfection of shopping trolleys, of wheelchairs or the disinfection of aerosol-containing air to reduce COVID-19



transmission were mentioned as possible applications. Using wheelchairs as an example, the results of microbiological investigations were compared with the disinfection effect of the modelled irradiance levels by the LEDs used.

8. Matthias Lechner (hollu Systemhygiene)

Matthias Lechner reported in his presentation on the hygiene manager app "NOA" (Navigation and Organisation Assistant), which was developed as a personalisable app on mobile phone, tablet or PC to support cleaning and hygiene measures. With the NOAteam user administration, area structures, work plans and work steps to be carried out can be displayed in detail. The app can be personalised in great detail with pictures, pictograms and logos, depending on the customer's wishes. Via the user tool NOAguide, the persons carrying out the work can, on the one hand, carry out the necessary work in NOA as if according to a checklist, have work protocols summarised, retrieve information and log obligatory proofs, e.g. of disinfections carried out. Another advantage is that safety data sheets on the products used and user information can be called up and accessed at any time via mobile phone or tablet using the app. Planning procedures before starting work is also possible with the NOA app. Via the myNOA dashboard, managers and hygiene officers have an overview of the activities that have already been completed and confirmed, which makes planning and documentation much easier. Connections of NOA to webshops and IoT-capable devices are also possible. Due to the advantages of the freely selectable adaptations of NOA, other applications, such as the execution and documentation of SOPs in clean rooms or the planning and organisation of snow clearance in municipalities and other areas of application are also conceivable.

9. Prof. Dr. Kimmel (Niederrhein University of Applied Sciences)

Using two examples, Prof. Dr. Kimmel from the Niederrhein University of Applied Sciences presented the current status and future of autonomous floor cleaning.

As the best-known example of a household robot, the development of Hoover robots was traced, where several generations can be distinguished since the market launch in the 1990s. From the beginning, there were devices that had high-quality equipment with sensors and a powerful control system. However, due to the several times higher price compared to manually operated devices, these could not establish themselves. This was only achieved with a generation of simplified and cheaper devices. Currently, both cheaper and more powerful devices can be found on the market and the sales figures are in the range of several million units per year. The situation is quite different for autonomous cleaning devices for the professional sector. Scrubber driers are typical professional cleaning devices. Brushes clean the floor with a high contact pressure, while a cleaning fluid is directed onto the floor in front of the brushes and extracted behind the

device. In total, the number of robotic scrubbers sold in Europe since their market launch is only about 500 units. Important obstacles to a broader market penetration are, for example, the payback period and exaggerated expectations in the market. For example, the payback period of 2-3 years is currently longer than the contract period of 1-2 years of building service providers for properties where these devices could be used. In addition, the customers of the facility service providers associate significant cost reductions with the use of cleaning robots, which are currently not yet realisable. Nevertheless, since all indicators on the market, such as the lack of workers in the cleaning industry, the increase in the age of the workforce as well as advances in automation, speak in favour of the use of cleaning robots, almost all well-known manufacturers have included scrubbing robots in their range of products and assume that the breakthrough is imminent.

10. Zena Malocho (Institut Fresenius)

Ms. Zena Malocho presented results of application-technical investigations of bathroom and sanitary cleaners against the background of whether differences can be found in cleaners with and without eco-certification. For this purpose, 27 commercial and consumer products were compared with each other. These included ready-to-use (RTU) as well as products to be diluted. These were diluted according to the manufacturer's instructions. The limescale dissolving capacity and the limescale soap dissolving capacity were investigated. To investigate the lime dissolving capacity, marble slabs were immersed in the respective solutions for 10 minutes and the changes were determined gravimetrically afterwards. To determine the lime soap dissolving capacity, the time needed to remove 90% of the dirt was measured.

The evaluation showed that comparable results were obtained for RTU products in both tests, but not for the concentrates. There is a need to develop a new method to compare diluted detergents. The RTU products without eco-certification showed significantly better results in terms of limescale dissolving capacity than those with certification. On average, 1700 mg of lime were dissolved from the marble slabs. The commercial products performed significantly better than the consumer products. When dissolving lime soap, however, no significant difference could be shown between the products with and without eco-certification. Likewise, the consumer products were able to keep up with the industrial cleaners despite negative outliers in terms of dissolving grime.

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