10/23 | Volume 149 | Thannhausen, Germany, October 16, 2023

sofw journal

Home & Personal Care Ingredients & Formulations

powered by SOFW

column

The Poly-Crisis – the Opportunity for Truly Meaningful Innovations

disinfection

Modern Ready to Use Disinfecting Wipes

10
2023
english

surface tension

Determination of Surface Tension of Surfactant Solutions from a Regulatory Perspective

home care

Deep-cleaning and Freshness for Sustainable Laundry with Dispersin

Multifunctionals as Innovative Solutions for Formulating Modern Home Care Products

rinse aids

A Simple Laboratory Method for Evaluating the Performance of Rinse Aids

personal care

A Biomimetic Anti-sagging Ingredient

Greek Mountain Tea for Beauty Sleep and Night-Time Recovery

Rapid Microbial Quality Control Methods Increase Supply Chain Speed

specialties

How to Increase Efficiencies in Cosmetic Emulsion Production While Simultaneously Reducing Emissions?

Water-soluble or Not? A Simple Question Difficult to Answer

Home Care and I&I Solutions Europe

Experience the Change

Lavergy® M Ace 100 L:
New mannanase for a powerful and sustainable laundry performance

Sokalan® Ecopure C:
New biodegradable polymer supports multiple automatic dishwashing detergent formats

BASF
We create chemistry

home care 12
rinse aids
A Simple Laboratory Method for Evaluating the Performance of Rinse Aids

20 home care
disinfection
Modern Ready to Use Disinfecting Wipes – What You Need to Know

column

home care

home and personal care

personal care

specialties

SEPAWA® news

interviews

COLUMN

The Poly-Crisis – the Opportunity for Truly Meaningful Innovations

J. Bode

No matter which information channel we use, whether it's the traditional newspaper or various online feeds, the day begins with crises in all areas. Escaping them seems almost impossible.

When individual issues and crises accumulate, they develop into a permanent crisis and poly-crisis. Poly-crises refer to multiple crises that reinforce each other. The feeling of "not having control anymore" and being externally driven is mentally exhausting, tiring, and gradually and unconsciously affects our actions – even with our customers. Taking this relevant insight serious and implementing actions is a crucial advantage and an edge to your company.

Reaction vs. Proactive Action. There are the preservers, the fearful, who tend to shy away and show no reactions, vs. the doers, who proactively use external influences and boldly create new solutions for their customers and even potential customers. The challenge for companies is not to retreat or remain passive, but to learn and show understanding for the emotions of persons.

What's actually happening out there?

The poly-crisis was a central topic at the World Economic Forum in Davos and was described as an unprecedented historical period where global crises of various kinds mutually reinforce each other: ecological crises, economic crises, war-related crises, and social crises.

We are all experiencing an intense time unlike anything seen in previous generations, with enormous personal implications – and ultimately for our target audiences as well.

Are you familiar with the concept of "liquid times"? This theory describes a new way of life where "thinking, planning, and acting" no longer serve us as they used to. In this time of uncertainty and rapid change, consumer attitudes are evolving towards a new holistic and interconnected system of needs. The central theme is: meaning, for 'my life,' and universal security.

Drivers of the future.

"Fear and unrest" are significant emotional drivers for new consumer needs, and understanding this change is crucial for your insight and innovation management – but knowledge alone must turn into active action, meaning the implementation of "new customer needs" into your brand strategy and innovation pipeline.

What are the current "fears" of consumers?

According to the 2023 Edelman Trust Barometer, the top fears are: job loss or inflation (89%), the climate crisis (76%), and a possible nuclear war (72%). Additionally, there are concerns about resource scarcity, cyber insecurity, and mass migration (WEF). And now? Reactions range from closing your eyes, crossing arms, staying put and pessimism, versus opening the eyes, taking matters into your hands, embracing change, and showing optimism.

Yesterday › today ›› tomorrow:

in the upcoming years, it will be crucial for companies to develop a high degree of empathy, to listen, understand, translate customer fears into positive storytelling, meaningful solutions, and products.

The need for holistic authenticity.

As innovators, we're all familiar with the term VUCA. Currently, both we and our customers are experiencing a VUCA landscape cubed – characterized by volatility, fear of the future, complexity, and ambiguity – consumers are increasingly confused about the reality surrounding them, which they can barely control anymore.

A first step.

As innovative individuals, we have the mindset of continually self-questioning in a constructive way, reinventing ourselves, and this applies to the products and business models we offer as well. **Keyword: value-added solutions.** The value and upgrade sought now are security and trust – built through lived authenticity and transparency, in all dimensions – and there's room for improvement in this regard for many companies.

TRANSPARENCY



The poly-crisis changes how people seek, absorb, and process information, how they try to understand the world – above all, who, which companies, and which brands they trust and entrust with their budget.

Keyword: truth, meaning secure, credible, honest information. Consistently saying 'no' to: "If you can't convince, confuse," keyword: **'greenwashing'**. Personally, I now take it upon myself to contact companies and ask if they understand what they're communicating – on their websites or packaging. I live in Germany, and I believe we're the champions of bureaucracy, so now I send back any incomprehensible communication, asking them to send me the information in understandable customer language. My intention here isn't to complain but to hold up a mirror to the authors and have it explained in simple terms. I've had fascinating experiences here, from complete lack of understanding that I, as a customer, am even inquiring, to hearty laughter on the other end while attempting to understand their own language.

Call-to-action: Make it simple and make it simple.
Values like honesty, simplicity, and authenticity are obligations for entrepreneurs, and that's also an upgrade of sustainability – and now more than ever, 'walk the talk' matters.

If you're looking for more trend horizons for your solutions, here are some keywords: **Social Responsibility – Ethical Consumption – Localism – Responsibility – (Mental) Wellbeing – Experience Economy – Personal Interconnections – Social-economic Change – Simplicity – Risk Aversion – Authenticity – Trust & Transparency**. Each of these keywords is an inspiring platform and opportunity to challenge your current solutions or invent new ones.

Stop just selling products and start helping 'people' – then your customers will become fans, and your products will practically sell themselves.

Perhaps now is the perfect time not only to follow trends but to set them and, in addition to Insight & Foresight Management, install a 'Transparent Management.'

What relevant products and solutions do you offer to give people more than a feeling of security and comfort, to support them in understanding the world again and making their lives 'easier'?

Best of luck and above all, have fun with the implementation.

Jens Bode

ceo: instant innovate ug
(limited liability)

inspiration >
transformation >>
innovation >>>
innologe.com

picture credits: https://de.freepik.com, Katrin Heyer

Deep-cleaning and Freshness for Sustainable Laundry with Dispersin

R. Munk Vejborg, M. Kandzia, L. J. Nielsen, T. Wilke, T. Rechenbach, K. E. Thuesen, M. Weide

abstract

The continuously improved energy efficiency and reduced water usage of domestic laundry appliances has improved the environmental footprint of washing considerably. But the sustainability-driven shift towards lower washing temperatures, and the increasing use of bleach-free detergents, may unfortunately negatively impact laundry freshness and hygiene. This calls for new innovation for the sustainable detergents of tomorrow. Here we show that with the use of a nature-based dispersin enzyme technology, deep-cleaning and malodor prevention is possible, on textiles and in the washing machine, even at low temperature washing with liquid and single-dose detergents. This shows that it is possible to formulate detergents that can enable the consumers to wash their clothes sustainably without compromising washing performance.

Introduction

Over the past years, the laundry process has changed significantly in terms of sustainability, ease-of-process, and fabric care. In Europe, there has been a continued push for an improved energy efficiency (i.e. lower wash temperatures) and a reduced water consumption in domestic laundry [1]. Laundry detergents are becoming more compact and environmentally friendly, and bleach-free liquid detergents and other formats (e.g. single-dose detergents) are increasing in popularity [2,3]. Another prominent shift in consumer habits is the increasing use of synthetic and delicate textiles. Synthetic textiles are often more sensitive to chemicals and high temperatures than cotton, and therefore need special care (e.g., lower washing temperatures and specialized detergents) [4]. These washing trends, however, all have an impact on laundry hygiene, and freshness, both in terms of textile and machine cleanliness and in terms of malodor control [5-9]. Washing performance is known to be being influenced by at least four parameters, including time, temperature, mechanical action and chemistry, all of which are interdependent (Sinner's circle). According to Sinner's principle, a decrease in one parameter can be compensated for by an increase in one or more of the other variables [10-12]. For example, studies have shown that a combination of longer wash cycles and optimized detergent formulations can compensate for lower washing temperatures in terms of stain removal [13-16]. However, data also suggests that this sustainability-driven shift towards lower wash temperatures negatively affects laundry hygiene and freshness [17-19]. Detergents containing activated oxygen bleach (AOB) systems can compensate for the lowered wash temperature to some extent, but bleach activators are typically poorly compatible with liquid formulations and less efficient at lower temperatures [5,20,21]. Rinse aid products containing quaternary ammonium compounds (QAC) may also enhance the hygiene efficacy of laundering [22], but QACs are inherently incompatible with anionic/non-ionic-based surfactant systems. While malodor can be masked by advanced perfume systems, giving the consumer the perception of cleanliness, masking does not solve the root cause of the problem. Hence, there is clearly a need for new transformational innovation for laundry freshness and deep cleaning that will bolster the consumer adoption of sustainable laundering in the future.

Malodor and other freshness issues in laundry has been linked to the build-up or retention of soils and malodorous compounds on textiles and in washing machines over time [7,19, 23,24]. While the exact composition of such recalcitrant laundry soil remains elusive, studies suggest that both bodily soils (e.g., sebaceous lipids, skin cell residues, sweat), complex microbially-derived bio-soil (e.g. secreted extracellular polymeric substances (EPS)), and inorganic matter are a part of it [25-27]. Not unexpectedly, considering the trend towards lower washing temperatures, the role of microbially-derived bio-soil has gained increased scientific interest recently [18,28,29]. The microbiota of domestic washing machines and of soiled textiles originate predominantly from the skin and the surrounding environment (including water supply), being determined largely by geo- and demographic factors as well as by textile and appliance characteristics, handling, and use [18,28,30]. Typical examples of laundry-relevant microorganisms include *Staphylococcus sp.*, *Micrococcus sp.*, *Bacillus sp.*, *Acinetobacter*, *Brevundimonas sp.* and *Pseudomonas sp.* [31-34]. Microorganisms such as these are known to produce and secrete extracellular polymeric substances, such as proteins, polysaccharides and eDNA, highly adhesive-like structures that can interact with and anchor other components to a

surface [35-39]. Interestingly, recent data has shown that residual microbial eDNA is an important constituent of laundry-relevant recalcitrant soils, binding to and linking organic residues such as sebum to the textile [25,40]. Many skin- and laundry-relevant microorganisms, are also known to produce and secrete proteins and carbohydrate-rich polymeric substances, such as poly-β-(1→6)-*N*-acetylglucosamine (PNAG), which can stick to the textile and attract dirt and other particles [39, 41]. The importance of microbial activity in malodor generation, ranging from smelly cheese to malodorous socks, is also becoming increasingly apparent [7,19,23,29,33]. In laundry, microorganisms can utilize residual organic residues on textiles as substrates, generating volatiles as by-products during proliferation [42-44]. Sweat-associated malodors have been linked to retention of volatiles as well as microbial metabolization of sweat components remaining on the textile, while musty or "wet fabric"-like malodors are typically associated with the washing process or soil in the machine itself [7,42,45]. Hence, ensuring sufficient cleaning of the textile and the machine is therefore critical for preventing malodor generation. One intriguing possibility is to target the sticky microbial polymeric components of the complex laundry biosoil. While surfactants are critical for deep-cleaning and the maintenance of freshness, recent studies have shown that the application of natural EPS-degrading enzymes such as proteases, nucleases and carbohydrases (e.g. dispersins) can boost the deep-cleaning efficacy of laundry detergents [25, 46-48]. In this study, the applicability of a natural dispersin enzyme (EC 3.2.1.52) for improving cleaning and laundry and machine freshness, was explored further.

Materials and Methods

The cleaning performance of the heavy-duty laundry detergents (HDD) was measured using simulated bio-soil stains with a crude EPS extract from a laundry-relevant microorganism, as well as real consumer laundry items. The bio-soil stains were prepared using crude EPS extracted from a *Pseudomonas fluorescens* isolate as previously described [49]. Pigmented stains were prepared on CD27 (Cotton, Warwick Equest) or washing machine-relevant-surfaces (stainless steel and plastic), using a blend of the crude EPS extract and an activated coconut charcoal powder (10 mg/ml, Avojo, Denmark). The stains were dried before use. Wash experiments were carried out in Miele Softtronic W1935 washing machines ("Koch/Buntwasch" program, 30°C, 16°dH) using liquid laundry detergents with and without dispersin (acquired from Novozymes A/S). Stain removal measurements were carried out using a Spectrophotometer CM-26dG

(Konica Minolta), and the delta performance was calculated as $\Delta Y = (Y_{\text{dispersin, after wash}} - Y_{\text{dispersin, before wash}}) - (Y_{\text{Control, after wash}} - Y_{\text{Control, before wash}})$.

Hard surface bio-soil stains were washed in microtiter plates under shaking conditions (1h, 450 rpm, 30°C). They were rinsed and dried O/N before being measured using a professional flatbed scanner (Epson Expression 10000 XL). The 24-bit pixel values from the scanned images were converted into values for red, green and blue (RGB), and the intensity values (Int) were calculated: Int = sqrt ($r^2+g^2+b^2$). The percentage stain removal (SR) was then calculated as $SR = ((Int_{\text{after wash}} - Int_{\text{before wash}})/(Int_{\text{clean}} - Int_{\text{before wash}})) \times 100\%$.

Cleaning performance on real consumer items was measured using dirty (used) pillowcases collected from volunteers, and T-shirts bought from Warwick Equest. The items were cut in halves, randomly labelled (half A/B), and washed at 30°C in tap water (Miele W1935). After drying, the items were rinsed in a detergent containing pigment soil (0.7g/L wfk09V pigment soil) to visualize the invisible bio-soil. The items were then dried, and a sensory panel was asked to assess the items in terms of visual preference (half A or B for each individual item).

Multicycle malodor wash methods were adapted from general standards for washing machines trials [50] and applied for assessing freshness and malodor on textile (in a 15-week wash-and-wear setup with polyester sport T-shirts) and in washing machines (in a multicycle washing trial with dirty laundry loads) at 30°C and 16°dH (Miele W1734/ W1935, cotton program). After repetitive cycles, a panel of trained sensory panelists were asked to assess the level of malodor and freshness, on a scale from 0 (fresh scent) to 3 (strong malodor) of the textiles and the washing machines.

Results and discussion

Deep-cleaning benefits of dispersin

Laundry bio-soil may be invisible initially, but will often accumulate and retain dirt over time, leading to visible staining and malodor issues. Efficient cleaning is critical to prevent this accumulation. Given that part of the recalcitrant soil is of microbial origin, the possibility of targeting the sticky polymeric components using dispersin, a well-known EPS-degrading enzyme, was explored further. To simulate the sticky polymeric bio-soil, present in real laundry and washing-machines, a crude complex EPS extract was isolated from a laundry-relevant microorganism and used to prepare bio-soil stains on textiles. The artificially soiled textiles were then washed in laundry detergents with or without dispersin. Interestingly, as seen in **Figure 1a**, dispersin significantly boosted the performance of the detergents irrespective of the surfactant and compaction level. This clearly suggests that targeting the sticky EPS components of laundry biosoil can improve deep-cleaning.

Given that part of the laundry freshness problems is related to lingering dirt and malodors inside the washing machine, an important criterion for preventing laundry malodor is to ensure that the machine itself stays clean and fresh. To test the efficacy of dispersin in relation to machine-relevant surfaces, simulated hard surface bio-soil stains (stainless steel and plastic surfaces) were also tested. As seen in **Figure 1b**, dispersin significantly improved the cleaning performance of the laundry detergents on the stainless-steel and plastic surfaces.

The next step was to examine whether the deep-cleaning properties of dispersin could also be detected directly on real laundry bio-soil (i.e., real consumer items) in a single wash.

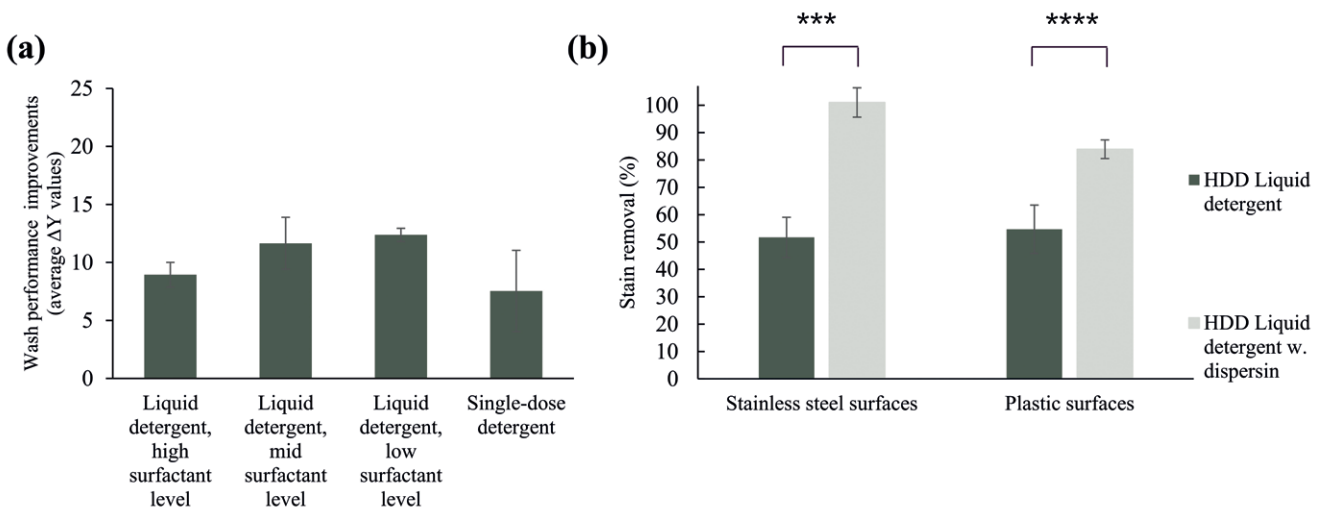


Fig. 1 Deep-cleaning performance of dispersin-containing detergents on textile- and machine-relevant surfaces. **(a)** Full scale wash trials with textile bio-soil stains. The graph shows the average wash performance improvement in various liquid and single-dose liquid laundry detergents at 30°C, when dispersin was added. Wash performances in the different laundry detergents are on the same high level. **(b)** Percentage stain removal on washing machine relevant surfaces (stainless steel and plastic bio-soil stains) after washing in liquid laundry detergent at 30°C for 1 h. Statistical significance, student's t-test, *** $p \leq 0.001$, **** $p \leq 0.0001$.

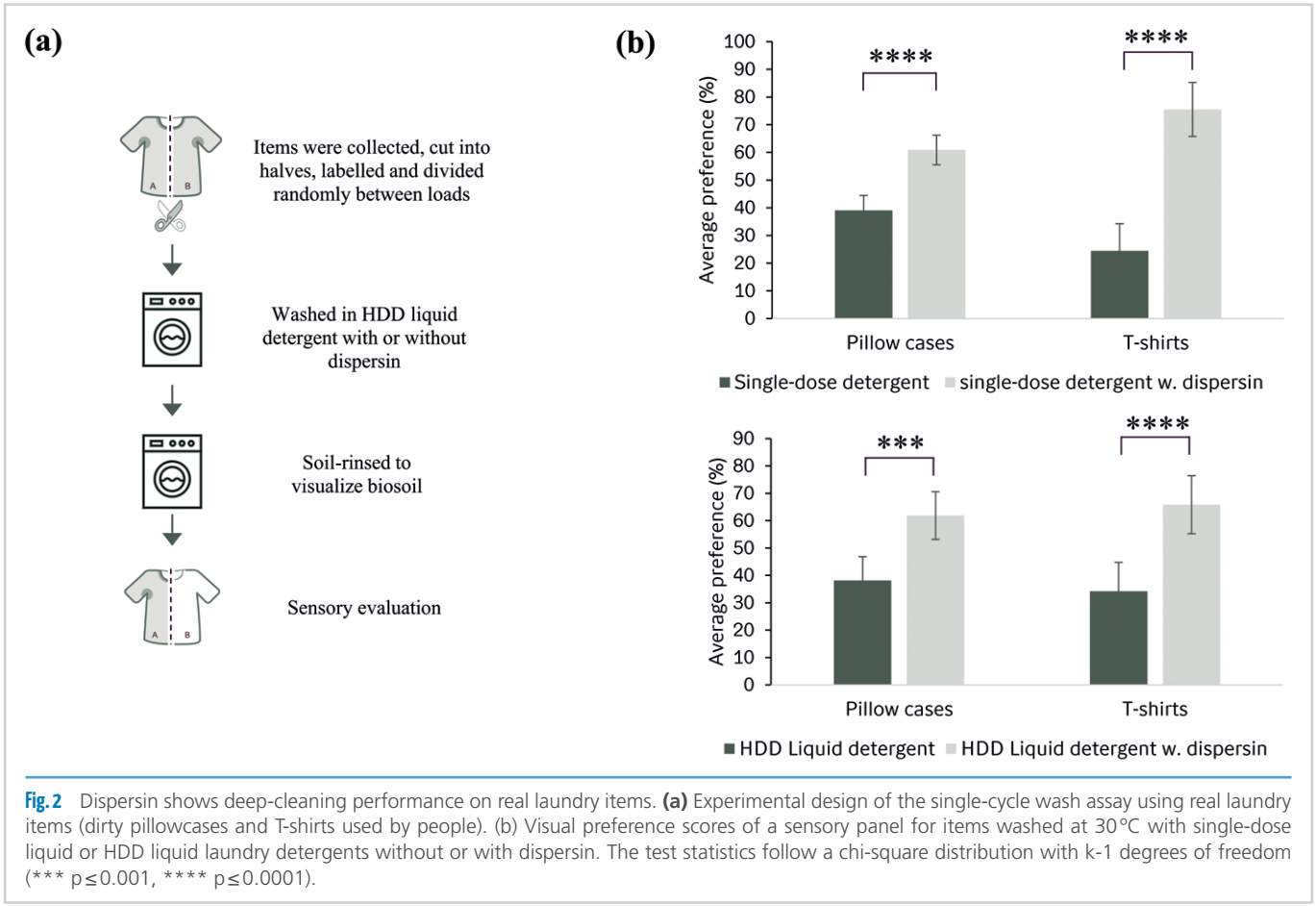


Fig. 2 Dispersin shows deep-cleaning performance on real laundry items. **(a)** Experimental design of the single-cycle wash assay using real laundry items (dirty pillowcases and T-shirts used by people). (b) Visual preference scores of a sensory panel for items washed at 30 °C with single-dose liquid or HDD liquid laundry detergents without or with dispersin. The test statistics follow a chi-square distribution with k-1 degrees of freedom (*** $p \leq 0.001$, **** $p \leq 0.0001$).

Close-to-practice trials with real dirty laundry items were therefore performed. In these trials, dirty (used) pillowcases and T-shirts were collected, cut in halves, and washed in liquid laundry detergents with or without dispersin. The items were then dried, and the invisible bio-soil was visualized with a subsequent rinse step with a carbon black-containing particulate soil (the sticky laundry bio-soil attracts the carbon black particles causing visible graying). A sensory panel was then asked to evaluate the items, based on the overall level of cleaning. In these trials, the dispersin-treated items were significantly preferred, confirming that dispersin also shows deep-cleaning performance on real laundry textiles **(Figure 2)**.

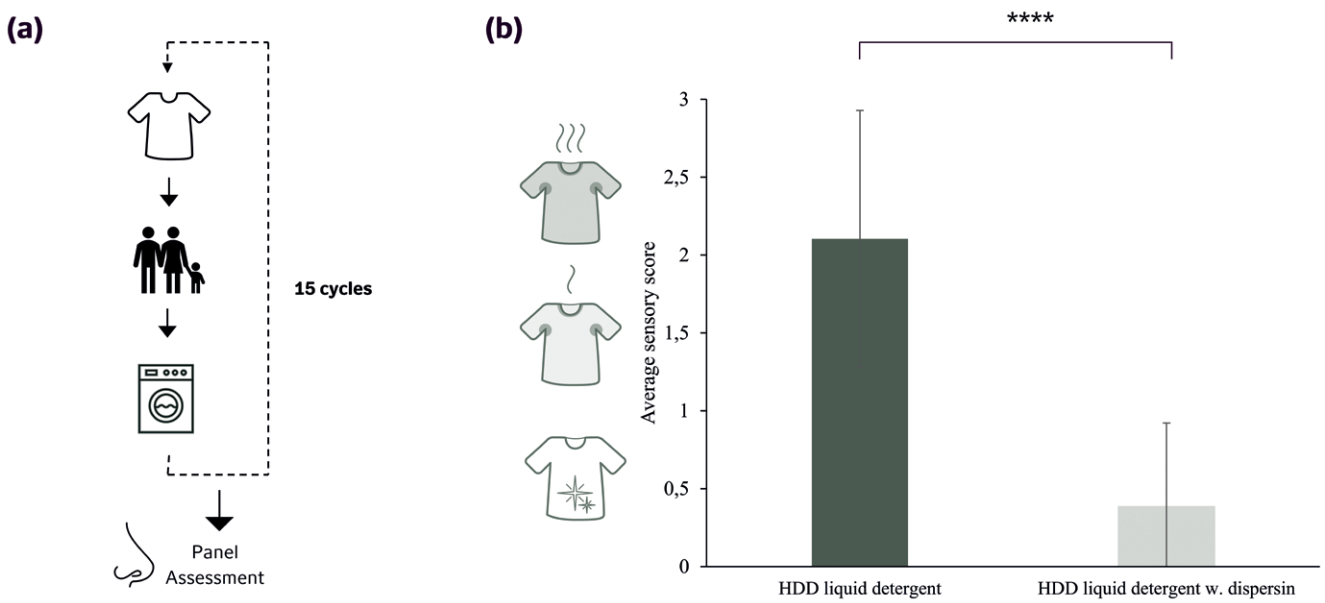


Fig. 3 Dispersin prevents malodor generation on real laundry textiles. **(a)** Experimental design of the wash and wear trial. Identical polyester sport T-shirts were handed out to 12 different test households. The T-shirts were used and washed (in HDD liquid laundry detergents without or with dispersin) over a period of 15 weeks (one cycle per week). **(b)** Sensory evaluation of the items after 15 cycles. The sensory panelists were asked to assess the level of malodor and freshness, on a scale from 0 (fresh scent) to 3 (strong malodor) of the textiles. Statistical significance is indicated with asterisks (student's t-test, **** $p \leq 0.0001$).

Promoting freshness and countering laundry malodor with dispersin

While visible staining and overall greying are common pain point for consumers, the predominant complaint arising when washing at low temperatures, is the generation and persistence of malodor (consumer study, data not shown). As previously mentioned, malodor issues associated with low temperature washing conditions are often linked with insufficient cleaning and lower hygiene, leading to the accumulation of bio-soil in fabrics and washing machines over time. Preventing this buildup should make it possible to reduce malodor generation, even at low temperature washing. To test whether dispersin could help prevent malodor buildup in real consumer items, given its deep-cleaning properties, a wash and wear experiment was set up. In this trial, identical polyester T-shirts were handed out to volunteers, who were asked to wear/use the items over a period of fifteen weeks. The items were then collected and washed each week in laundry detergent with or without dispersin. After fifteen consecutively cycles, a panel of trained sensory panelists were asked to assess the freshness/malodor, of the textiles. As seen in **Figure 3**, the items washed in the detergent containing dispersin were perceived as being fresh, while the items washed in the detergent alone were rated as highly malodorous. This shows that by improving the overall cleaning performance of the detergent, dispersin can help prevent malodor generation in textiles.

Following a similar rationale, additional trials were set up to also assess the impact on the washing machines themselves, another consumer pain point in terms of malodor. Identical washing machines with full textile loads (dirty) were washed repetitively with liquid laundry detergents with and without dispersin, respectively. After multiple cycles, a trained sensory panel were asked to rate the malodor intensity and freshness level of the washing machines by opening the machine door and placing their head and nose close to the empty drum. As seen in **Figure 4**, the panelists showed a clear preference for the dispersin-treated machines in both the single-dose and heavy-duty liquid detergent trials. Overall, this demonstrates that by targeting the sticky microbial part of laundry bio-soil, dispersin can help prevent malodor generation and promote freshness on textile and in the washing machine.

Conclusions

In this study we show that modern laundry detergents boosted by a new enzyme technology can help reduce laundry malodor and promote textile and machine freshness: By improving the deep-cleaning efficacy of laundry detergents with dispersin, malodor issues can be prevented even at low washing temperatures. This clearly suggest that it is possible to tackle the issues that arise in our pursuit for a sustainable future. Hopefully solutions like this can help strengthen the consumer willingness to accept and adopt sustainable laundering behaviors.

Acknowledgements

The authors would like to thank the volunteers who participated in the wash-and-wear studies and who contributed with dirty real items, and to the panelists participating in the freshness tests. Thank you to Brian Laufs, Cathrine T. Falkenham, Christian A. Christensen, Christian Degering,

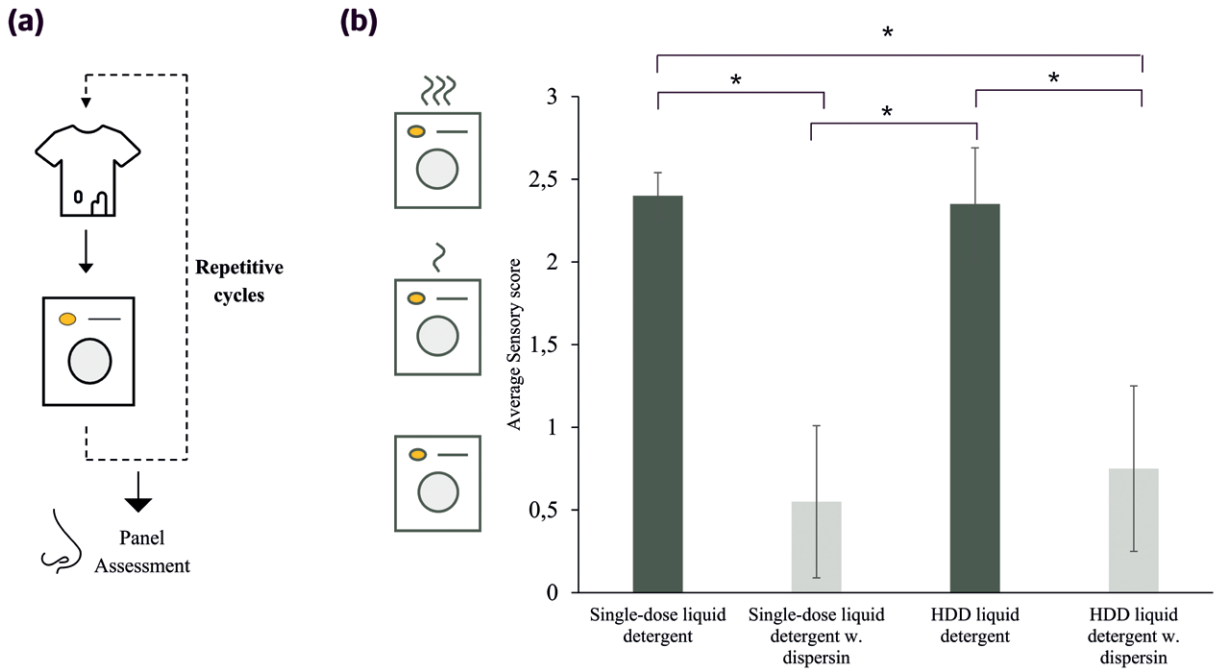


Fig. 4 Dispersin prevents malodor generation in washing machines. **(a)** Experimental setup of full-scale washing machine malodor trial for testing single-dose and HDD liquid laundry detergents without and with dispersin at 30 °C (Miele Softtronic W1935 WTL, "Koch/Buntwasch" program) to assess the impact on washing machine freshness and malodor. **(b)** Sensory evaluation of the machines at the end of the trial. The sensory panelists were asked to assess the freshness and malodor of the washing machines on a scale from 0 (fresh scent) to 3 (strong malodor). Statistical significance is indicated with asterisks (ANOVA, * $p \leq 0.05$).

Frank Janssen, Inken Prueser, Inga Vockenroth, Noelle Wrubbel, Stefan Evers, Susanne Wieland, Ulrike Denguth and Tan Zhang for general support of the project.

Conflict of interest

Henkel and Novozymes declare a commercial interest in the use of dispersin technology for household and laundry care cleaning applications.

References:

[1] Commission E. 2019. Commission Regulation (EU) 2019/2023. http://data.europa.eu/eli/reg/2019/2023/oj.

[2] AISE. 2020. A.I.S.E.'s pan-European habits survey 2020. International Association for Soaps DaMP, https://www.aise.eu.

[3] *Wagner G*. 2010. Waschmittel – Chemie, Umwelt, Nachhaltigkeit, 4.Edition ed, vol Wiley-VCH.

[4] *Opperskalski S, Franz A, Patanè A, Siew S, Tan E*. 2022. Preferred Fiber & Materials. https://textileexchange.org/.

[5] *Honisch M, Stamminger R, Bockmühl DP*. 2014. Impact of wash cycle time, temperature and detergent formulation on the hygiene effectiveness of domestic laundering. J Appl Microbiol 117:1787-97.

[6] *Bockmühl DP*. 2017. Laundry hygiene—how to get more than clean. Journal of Applied Microbiology 122:1124-1133.

[7] *Stapleton K, Hill K, Day K, Perry JD, Dean JR*. 2013. The potential impact of washing machines on laundry malodour generation. Lett Appl Microbiol 56:299-306.

[8] *Weide MR, Heinzel M*. 2000. Situation analysis of hygiene in the home. SOFW-journal 126:6-11.

[9] *Abeliotis K, Amberg C, Cevza C, Ferri A, Osset M, Owens J, Stamminger R*. 2015. Trends in laundry by 2030. Household and Personal Care Today 10:22.

[10] *Sinner H*. 1960. Über Das Waschen Mit Haushaltwaschmaschinen : In Welchem Umfange Erleichtern Haushaltwaschmaschinen Und -Geräte Das Wäschehaben Im Haushalt? Haus und Heim Verlag, Hamburg.

[11] *Damm H*. 1956. Probleme der Flaschenreinigung, p Rev. Sonderdruck aus, Der Naturbrunnen, März 1956 ed.

[12] *Müller-Kirschbaum, T. K, A., Scheidgen A*. 2020. 60 Jahre Sinnerscher Kreis: ein Blick in die Zukunft des Waschens. SÖFW-Journal 146:36-40.

[13] *Olsen HS, Falholt P*. 1998. The role of enzymes in modern detergency. Journal of Surfactants and Detergents 1:555-567.

[14] *Laitala K, Boks C, Klepp IG*. 2011. Potential for environmental improvements in laundering. International Journal of Consumer Studies 35:254-264.

[15] *Laitala K, Jensen H*. 2010. Cleaning Effect of Household Laundry Detergents at Low Temperatures. 47:413-420.

[16] *Janczak F, Stamminger R, Nickel D, Speckmann H-D*. 2010. Energy savings by low temperature washing. SÖFW-Journal 136.

[17] *Honisch M, Brands B, Weide M, Speckmann D, Stamminger R, Bockmuehl D*. 2016. Antimicrobial Efficacy of Laundry Detergents with Regard to Time and Temperature in Domestic Washing Machines. Tenside Surfactants Detergents 53:547-552.

[18] *Callewaert C, Van Nevel S, Kerckhof FM, Granitsiotis MS, Boon N*. 2015. Bacterial Exchange in Household Washing Machines. Front Microbiol 6:1381.

[19] *Munk S, Johansen C, Stahnke LH, Adler-Nissen J*. 2001. Microbial survival and odor in laundry. Journal of Surfactants and Detergents 4:385-394.

[20] *Schages J, Stamminger R, P. BD*. 2020. A New Method to Evaluate the Antimicrobial Efficacy of Domestic Laundry Detergents. Journal of Surfactants and Detergents 23:629-639.

[21] *Beck RHF, Koch H, Mentech J*. 1996. Bleach activators, p 295-306, Carbohydrates as Organic Raw Materials III.

[22] *Lucassen R, Merettig N, Bockmühl DP*. 2013. Antimicrobial Efficacy of Hygiene Rinsers under Consumer-Related Conditions. Tenside Surfactants Detergents 50:259-262.

[23] *Van Herreweghen F, Amberg C, Marques R, Callewaert C*. 2020. Biological and Chemical Processes that Lead to Textile Malodour Development. Microorganisms 8:1709.

[24] *Denawaka CJ, Fowlis IA, Dean JR*. 2016. Source, impact and removal of malodour from soiled clothing. Journal of Chromatography A 1438:216-225.

[25] *Morales-Garcia AL, Hayward AS, Malekpour AK, Korzycka KA, Compson R, Gori K, Lant NJ*. 2020. The Application of a Nuclease Enzyme to Clean Stubborn Soils and Odors in Laundry. Journal of Surfactants and Detergents 23:797-807.

[26] *Chi Y-S, Obendorf SK*. 1998. Aging of oily soils on textile materials: A literature review. Journal of Surfactants and Detergents 1:407-418.

[27] *Sainio E-L*. 1996. Detergent residues in textiles. Journal of Consumer Studies & Home Economics 20:83-91.

[28] *Jacksch S, König C, Kaiser D, Weide M, Ratering S, Schnell S, Egert M*. 2021. Metatranscriptomic Analysis of Bacterial Communities on Laundered Textiles: A Pilot Case Study. Microorganisms 9:1591.

[29] *Kubota H, Mitani A, Niwano Y, Takeuchi K, Tanaka A, Yamaguchi N, Kawamura Y, Hitomi J*. 2012. Moraxella species are primarily responsible for generating malodor in laundry. Appl Environ Microbiol 78:3317-24.

[30] *Jacksch S, Kaiser D, Weis S, Weide M, Ratering S, Schnell S, Egert M*. 2019. Influence of Sampling Site and other Environmental Factors on the Bacterial Community Composition of Domestic Washing Machines. Microorganisms 8:30.

[31] *Gattlen J, Amberg C, Zinn M, Mauclaire L*. 2010. Biofilms isolated from washing machines from three continents and their tolerance to a standard detergent. Biofouling 26:873-82.

[32] *Jacksch S, Zohra H, Weide M, Schnell S, Egert M*. 2021. Cultivation-based quantification and identification of bacteria at two hygienic key sides of domestic washing machines. bioRxiv:2021.02.19.431940.

[33] *Callewaert C, De Maeseneire E, Kerckhof FM, Verliefde A, Van de Wiele T, Boon N*. 2014. Microbial odor profile of polyester and cotton clothes after a fitness session. Appl Environ Microbiol 80:6611-9.

[34] *Novak Babič M, Zalar P, Ženko B, Schroers H-J, Džeroski S, Gunde-cimerman N*. 2015. Candida and Fusarium species known as opportunistic human pathogens from customer-accessible parts of residential washing machines. Fungal Biology 119:95-113.

[35] *Flemming HC, van Hullebusch ED, Neu TR, Nielsen PH, Seviour T, Stoodley P, Wingender J, Wuertz S*. 2023. The biofilm matrix: multitasking in a shared space. Nat Rev Microbiol 21:70-86.

[36] *Allesen-Holm M, Barken KB, Yang L, Klausen M, Webb JS, Kjelleberg S, Molin S, Givskov M, Tolker-Nielsen T*. 2006. A characterization of DNA release in Pseudomonas aeruginosa cultures and biofilms. Mol Microbiol 59:1114-28.

[37] *Mack D, Fischer W, Krokotsch A, Leopold K, Hartmann R, Egge H, Laufs R*. 1996. The intercellular adhesin involved in biofilm accumulation of Staphylococcus epidermidis is a linear beta-1,6-linked glucosaminoglycan: purification and structural analysis. J Bacteriol 178:175-83.

[38] *Blakeman JT, Morales-García AL, Mukherjee J, Gori K, Hayward AS, Lant NJ, Geoghegan M*. 2019. Extracellular DNA Provides Structural Integrity to a Micrococcus luteus Biofilm. Langmuir 35:6468-6475.

[39] *Roux D, Cywes-Bentley C, Zhang YF, Pons S, Konkol M, Kearns DB, Little DJ, Howell PL, Skurnik D, Pier GB*. 2015. Identification of Poly-N-acetylglucosamine as a Major Polysaccharide Component of the Bacillus subtilis Biofilm Matrix. J Biol Chem 290:19261-72.

[40] *Yau HCL, Malekpour AK, Momin NG, Morales-García AL, Willats WGT, Lant NJ, Jones CY*. 2021. Removal of eDNA from fabrics using a novel laundry DNase revealed using high-resolution imaging. Sci Rep 11:21542.

[41] *Cywes-Bentley C, Skurnik D, Zaidi T, Roux D, Deoliveira RB, Garrett WS, Lu X, O'Malley J, Kinzel K, Rey A, Perrin C, Fichorova RN, Kayatani AK, Maira-Litràn T, Gening ML, Tsvetkov YE, Nifantiev NE, Bakaletz LO, Pelton SI, Golenbock DT, Pier GB*. 2013. Antibody to a conserved antigenic target is protective against diverse prokaryotic and eukaryotic pathogens. Proc Natl Acad Sci U S A 110:E2209-18.

[42] *McQueen R, H., Harynuk JJ, Wismer WV, Keelan M, Xu Y, De la Mata P*. 2014. Axillary odour build-up in knit fabrics following multiple use cycles. International Journal of Clothing Science and Technology 26:274-290.

[43] *McQueen R, Laing R, Delahunty C, Brooks H, Niven BE*. 2008. Retention of axillary odour on apparel fabrics. Journal of the Textile Institute 99:515-523.

[44] *Møllebjerg A, Palmén LG, Gori K, Meyer RL*. 2021. The Bacterial Life Cycle in Textiles is Governed by Fiber Hydrophobicity. Microbiol Spectr 9:e0118521.

[45] *Chung H, Seok H*. 2012. Populations of Malodor-forming Bacteria and Identification of Volatile Components in Triolein-soiled Cotton Fabric. Fibers and Polymers 13.

[46] *Oehlenschlaeger CB, Segura DR, Vejborg RM, Geertz-Hansen HM, Baltsen LET, Salomon J*. 2017. Detergent composition and uses thereof, WO 2017/186943.

[47] *Monrad RN, Vejborg RM, Salomon J, Segura DR*. 2020. Cleaning compositions and uses thereof, WO 2020/007863.

[48] *Gori K, Allesen-Holm M, Baltsen LET, Noergaard A, Lehmbeck J*. 2015. Detergent composition, WO 2015/155350.

[49] *Vejborg RM, Segura DR, Salomon J, Jensen JM, Monrad RN, Due AV, Gudmand M*. 2019. Polypeptides and compositions comprising such polypeptides, WO 2019/086530.

[50] *Smulders E, von Rybinski W, Sung E, Rähse W, Steber J, Wiebel F*. 2002. Laundry Detergents. Wiley-VCH Verlag GmbH.

authors

Rebecca Munk Vejborg[a], Michael Kandzia[b], Lasse Janniche Nielsen[a], Thomas Wilke[b], Thomas Rechenbach[b], Kenneth Efterstigaard Thuesen[b] and Mirko Weide[c]

[a] **Consumer Biosolutions | Novozymes A/S**
Krogshøjvej 36 | 2880 Bagsværd | **Denmark**

[b] **International R&D – Henkel Consumer Brands**
Henkel AG & Co. KGaA | Henkelstr. 67 | 40191 Düsseldorf | **Germany**

[c] **Corresponding Author: Dr. Mirko Weide**
Head of Microbiology & Hygiene

International R&D – Henkel Consumer Brands
Henkel AG & Co. KGaA | Henkelstr. 67 | 40191 Düsseldorf | **Germany**
Phone: +49 211 797 4691 | **Fax:** +49 211 798 14691
Mobile: +49 151 6800 4691 | **E-Mail:** mirko.weide@henkel.com

IMCD

Sustainable Solutions

We help you navigate the sustainability landscape

IMCD Home Care and I&I is dedicated to supporting its partners in their quest for sustainable solutions, paving the way for a cleaner, safer, and more circular future.

Our approach makes it easy for our customers to:

- **Understand** what sustainability means in the HI&I industry
- Approach sustainability in an easy-to-understand and **practical manner**
- Access a **carefully selected portfolio** of sustainable products
- Switch to using **greener solutions** in their products

Together, we can create sustainable solutions that elevate performance.

IMCD HI&I

Start your sustainability journey with IMCD

SCAN ME

www.imcdgroup.com

Creating a world of opportunity

A Simple Laboratory Method for Evaluating the Performance of Rinse Aids

B. R. Wulff

abstract

When evaluating the performance of detergent formulations for automated cleaning applications, many different aspects have to be considered, which can be objectified to varying degrees. For example, while numerous methods are available for evaluating cleaning performance on a laboratory scale or in machine application, evaluating the performance of rinse aids is a much greater challenge. This is usually done by relying on a more or less subjective visual assessment of testing conducted in a dishwasher. Especially during formulation development, the developer often lacks a tool that allows a quick comparison of different formulations or makes it possible to check the success of modifications without the need for elaborate machine testing. The laboratory method presented here allows the comparison of rinse aids with regard to their flow-off behaviour under different application conditions with very little expenditure of time and resources.

Introduction

Objectively evaluating the performance of rinse aids is a challenge. Almost all established methods are based on a purely visual assessment and the more or less subjective evaluation by people, for example by counting drops or spots (spotting) on the wash ware after a machine rinse cycle or by visually assessing the extent of deposit or film formation (filming) [1]. By using integrated scales [2] or automation and digital image analysis, it has already been possible to objectify these machine-based methods to some extent in recent years [3,4], but they are still associated with a relatively high level of equipment and time expenditure.

Especially during the development or optimisation of a formulation, it is indispensable for the formulator to be able to check and compare the performance of test formulations using suitable methodology without great effort. While certain characteristics of a rinse aid, such as foaming behaviour, neutralisation capacity or binding of water hardness can be measured, there is no corresponding, simple method that allows an objective quantification of the run-off behaviour or drying capacity, although this is a decisive performance characteristic of a rinse aid formulation.

The experimental set-up presented in the following **(Figure 1)** enables the quantitative comparison of formulations with regard to their flow-off behaviour under different application conditions with very little experimental effort.

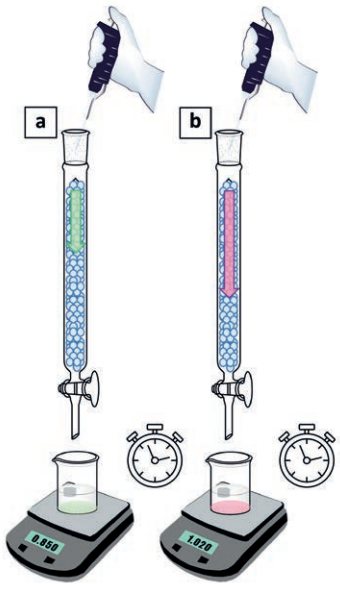


Fig. 1 Schematic representation of the experimental set-up for the comparison of two solutions **[a]** and **[b]**.

Description of the Method

A chromatography column (e.g. NS 29/32, length 30 cm) is first filled with commercially available Raschig rings measuring 6x6 mm. Due to their shape, these offer a large total surface area in relation to the filling volume of the column and are thus ideally suited for investigating the interactions of a solution with a material surface. Using a micropipette, a defined quantity (e.g. 10 ml) of an application dilution of the rinse aid formulation to be investigated is added to the column and a time measurement is started at the same time. The solution now runs down the column and is collected in a beaker on an analytical balance. After defined time intervals, the mass of the collected application solution is noted. For the tests described here, intervals of 10 s and a total test period of 120 s per experiment were selected. In this way, it is possible to determine both the amount of solution that has flowed off or the residue remaining on the column after a defined time and also to observe the kinetic flow-off behaviour for the respective rinse aid solution. After each individual experiment, the chroma-

tography column and filling material are thoroughly rinsed first with deionised water, then with acetone and finally dried in a drying oven.

An experiment with pure deionised water without addition serves as a reference. All experiments are carried out as multiple determinations.

In order to take into account the different materials that are used as wash ware in practice, Raschig rings made of glass, plastics or possibly other materials such as stainless steel can be used as filling material for the chromatography column. In addition, as a rule, rinse aids are not used at room temperature, but typically in a range of about 50 °C to 90 °C. Since at higher temperatures it is to be expected that the flow-off behaviour and other properties of the application solutions change, tests that are carried out exclusively at room temperature are accordingly only of limited significance. In order to take this fact into account, experiments can be carried out at higher temperatures by heating the test solution to the desired temperature and tempering the apparatus including the filling material before starting the experiment. For example, temperature-controlled or thermally insulated columns can be used.

Practical Application

The experiments described below are intended to show by way of example how the method can be used to select, from a number of different formulations, the one that is most suitable for a particular application. In the example, a rinse aid solution is to be identified that exhibits particularly good flow-off or drying behaviour for use on polyethylene wash ware at a temperature of 60 °C.

General Differentiability

In order to first demonstrate that the described test set-up is suitable for differentiating rinse aids on the basis of their flow-off behaviour, eight test formulations I-VIII were tested against deionised water as a reference. For the purpose of illustration, this is a representative selection of rinse aid formulations that are as different as possible for different areas of application and have typical compositions for the respective application. The concentration of the application solutions was 0.08 % (0.8 g/kg) in each case, and the tests were carried out at room temperature with Raschig rings made of glass as filling material. The results of the test se-

Test solution	Flow rate [%] after 120 s (ø n=3)
Deionised water (reference)	54
I	78
II	61
III	54
IV	60
V	79
VI	75
VII	71
VIII	68

Tab. 1 Determined flow-off quantity after 2 min (glass, r.t., c = 0.08 %)

ries are shown in **Figure 2** and **Table 1**. The curves shown are mean values of a triple determination.

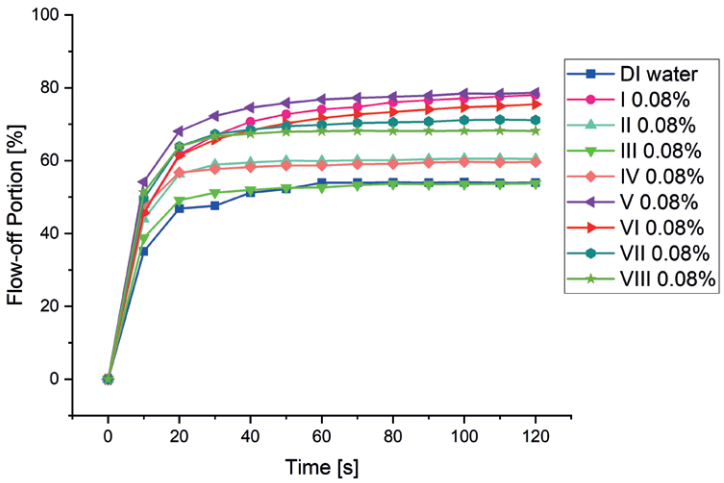


Fig. 2 The percentage flow-off quantity of formulations I-VIII as a function of time (c = 0.08 %, glass, r.t.); mean values (n=3)

The differences in performance of the individual formulations compared to the reference measurement with water were very clear here. As expected, the lowest flow-off quantity was measured with water and was 54 % of the amount of liquid added to the column. The best flow-off behaviour was shown by test solution V, with which 79 % of the initial quantity was recovered. Only 21 % residue remained on the column when using rinse aid V and thus 25 % less solution than with pure water under the same conditions. The flow-off behaviour of this rinse aid was thus almost 50 % better than that of the reference. As can be seen in **Figure 2**, the other test solutions showed different behaviour, so that the entire range between the reference and rinse aid V is covered.

Influence of the Material

The materials the wash ware is made of are a decisive factor in determining which type of rinse aid is suitable for a particular application. Therefore, the behaviour of a rinse aid on different materials must already be taken into account when developing the formulation. As an example, the series of tests described above was repeated with Raschig rings made of polyethylene (PE) under otherwise identical conditions. The results can be found in **Figure 3** and **Table 2**.

Test solution	Flow rate [%] after 120 s (ø n=3)
Deionised water (reference)	57
I	77
II	54
III	46
IV	76
V	73
VI	78
VII	74
VIII	74

Tab. 2 Determined flow-off quantity after 2 min (PE, r.t., c = 0.08 %)

If we now compare the results on PE with those on glass, the material influence is very clearly recognisable. With polyethylene as column filling the test solutions, unlike on glass, can be clearly divided into two categories: those that flow off the plastic surface better than water (I as well as IV-VIII) and those that interact strongly with the material and show poorer flow-off behaviour than water (II, III). On the basis of this, it would be possible to assess, in the course of formulation development, whether a formulation is likely to be suitable for use with wash ware made of PE or comparable plastics or not.

Influence of Temperature

If a detergent is used at higher temperatures, not only the general decrease in viscosity but also the cloud points of the surfactants contained in the formulation come into play, which can

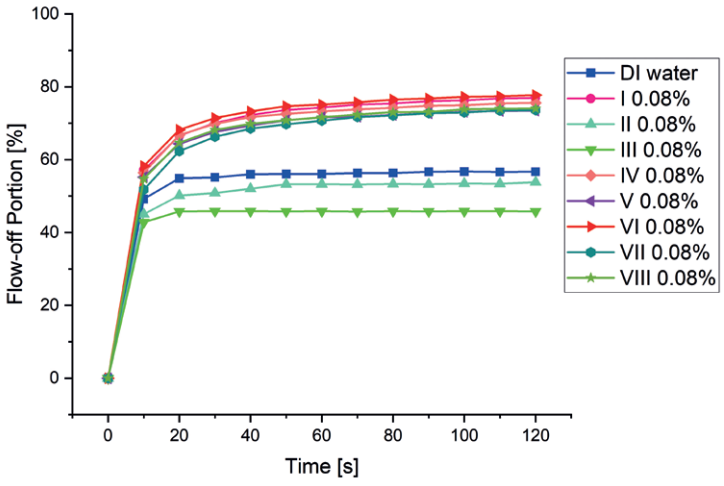


Fig. 3 The percentage flow-off quantity of formulations I-VIII as a function of time (c = 0.08 %, PE, r.t.); mean values (n=3).

Test solution	Flow rate [%] after 120 s (ø n=3)
Deionised water (reference)	53
I	63
II	57
III	52
IV	56
V	62
VI	56
VII	61
VIII	78

Tab. 3 Determined flow-off quantity after 2 min (PE, 60 °C, c = 0.08 %)

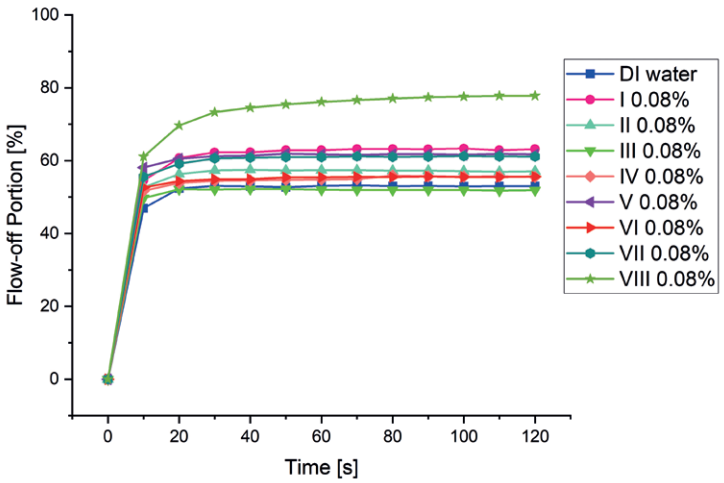


Fig. 4 The percentage flow-off quantity of formulations I-VIII as a function of time (c = 0.08 %, PE, 60 °C); mean values (n=3)

significantly change the wetting and flow properties of the application solution. If, for example, the aim is to identify a rinse aid that is intended for practical use at 60 °C or higher on polyethylene wash ware, this must be taken into account when selecting the test conditions, as the experiment described below clearly demonstrates.

The series of experiments shown above on PE as a filling material was carried out at approx. 60 °C instead of room temperature. **Figure 4** and **Table 3** show the corresponding measurement results.

While at room temperature six of the rinse aids tested achieved a relatively high flow-off quantity and were thus suitable for use on polyethylene (cf. **Figure 3**), when the test series was carried out at 60 °C **(Figure 4)**, it became apparent that only formulation VIII showed significantly improved flow-off behaviour compared to deionised water under these conditions. Surprisingly, the other test solutions I-VII showed

only slight to moderate differences to the reference. Depending on the composition of the formulation, the application temperature and the material can thus influence the flow-off behaviour both positively and negatively and so play a decisive role in the performance of the rinse aid.

However, the flow-off behaviour at lower temperatures than the actual rinse temperature can also be relevant for the drying performance, especially for wash ware made of materials such as glass or plastics, which only absorb small amounts of heat in the machine process and during the rinse and cool down again quickly or, for example, when the post-drying takes place outside the machine. Precise knowledge of the application parameters is therefore crucial for the experimental design.

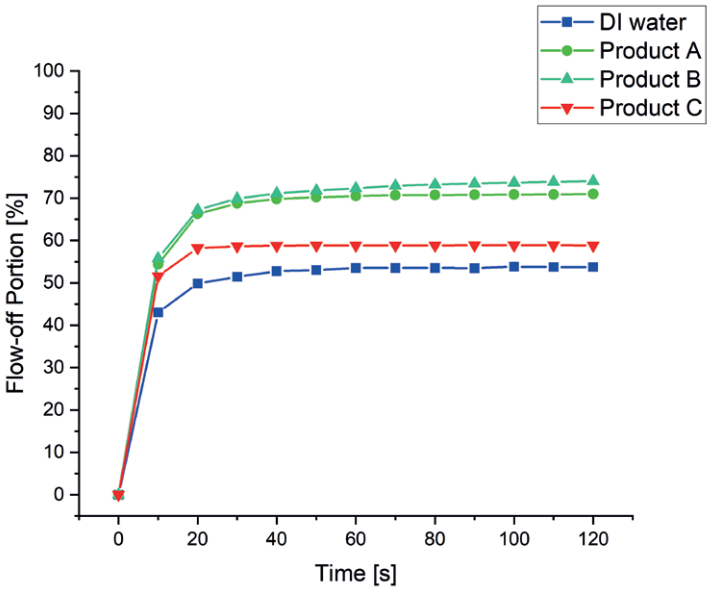


Fig. 5 The percentage flow-off quantity of tested rinse aids A-C as a function of time (c = 0.08 %, glass, r.t.); mean values (n=10)

Testing the Practical Relevance of the Method

As part of a study conducted by Stiftung Warentest in 2017, 19 rinse aids were examined and compared with regard to their rinsing and drying performance, among other things [5]. This was done using the classic test methods with visual evaluation of the rinsing result. Of the rinse aids tested, two products (A) and (B) were selected whose rinsing performance was rated very good (1.5) and whose drying performance was rated good (1.7), as well as another rinse aid (C), which was only rated sufficient (3.8) for rinsing performance and satisfactory (3.0) for drying performance.

These three rinse aids were tested with regard to their flow-off behaviour using the method presented here; the results are shown in **Table 4**. Tests with pure deionised water or tap water (approx. 12 °dH) without product dosing again served as reference experiments. In addition to the averaged measurement results, the difference Δ to the reference value with water is given in brackets in each case.

Under all tested experimental conditions, the three rinse aids in application dilution showed better flow-off behaviour than water of the respective quality used without product dosing.

The performance evaluation of the rinse aid test by Stiftung Warentest based on the classic visual evaluation could be reproduced in a qualitatively consistent manner, provided that the tests were conducted at room temperature (see **Figure 5**). Both products (A) and (B) showed similar results and clearly better flow-off behaviour than product (C), especially on glass and when using deionised water.

However, if the measurements were carried out at 50 °C, all three products showed very similar flow-off behaviour and it was no longer possible to clearly differentiate the performance. For the comparative evaluation of the results from the laboratory tests and the practical tests, the application conditions must be taken into account. Since in the rinse aid test the dishwasher was not opened until 30 min after the end of the programme and the drying behaviour was evaluated afterwards [5], the temperature of the wash ware and the remaining solution decreases during this period. It therefore suggests itself that the assessment of the flow-off behaviour from the laboratory tests at lower temperatures is more in line with the machine test results than the experiments at 50 °C.

	DI water, glass, r.t. 0.08 % (ø n=10)	DI water, glass, 50 °C 0.08 % (ø n=3)	SW (12 °dH), glass, r.t. 0.08 % (ø n=3)	SW (12 °dH), glass, 50 °C 0.08 % (ø n=3)	DI water, PE, r.t. 0.08 % (ø n=3)	DI water, PE, 50 °C 0.08 % (ø n=3)
Product (A)	71 % (Δ +17 %) s = 2.1	58 % (Δ +4 %)	69 % (Δ +18 %)	57 % (Δ +7 %)	65 % (Δ +8 %)	58 % (Δ +12 %)
Product (B)	74 % (Δ +20 %) s = 2.8	58 % (Δ +4 %)	68 % (Δ +17 %)	54 % (Δ +4 %)	65 % (Δ +8 %)	54 % (Δ +8 %)
Product (C)	59 % (Δ +5 %) s = 3.7	57 % (Δ +3 %)	62 % (Δ +11 %)	58 % (Δ +8 %)	62 % (Δ +5 %)	55 % (Δ +9 %)
Reference	54 % s = 2.4	54 %	51 %	50 %	57 %	46 %

Tab. 4 Determined flow-off quantity after 120 s

symrise

Home Care

SMART PERFORMANCE

Developing innovative ingredients without compromising on performance and sustainability is the core of what we do. Multifunctional ingredients are key, in addition to meet the market requirements of transparency and sustainability they bring multiple benefits in formula:

#CLEANING PERFORMANCE
#PRODUCT STABILIZATION
#PRODUCT AESTHETIC
#SENSORY EXPERIENCE

HOME CARE INGREDIENTS BY SYMRISE
always inspiring more...

www.symrise.com
Follow us on Linkedin & Instagram @symriseag

The test results show that with the help of the laboratory method a practical assessment of the performance of rinse aid formulations is possible. However, the knowledge of the exact application conditions and thus the choice of test conditions is of decisive importance.

Measurement Error Analysis

The aim of the method development presented here was to provide the product developer with a method that is easy to use, requires little time and effort to apply and uses only materials that are part of the basic equipment in every laboratory. A potential source of error in this experimental set-up is in particular the application of the solution to the chromatography column. Likewise, because of the relatively compact set-up, application solutions that show strong material interactions can lead to a greater scattering of the measurement results than those that flow easily off the column filling. To minimise the influence of both factors, it may be useful to increase the number of individual measurements per test. In addition, to avoid volume errors, e.g. by using warm test solutions, a pipetting error can be determined in advance by weighing and the results subsequently corrected accordingly.

Certain aspects of an automated application, such as the rinsing mechanics, more complex temperature curves, such as during post-drying, or macroscopic properties of rinsed goods, cannot be reproduced with such an experiment, or only to a limited extent, so that the subsequent transfer and verification of the laboratory results in the machine remain indispensable.

Summary

With the help of the laboratory method presented here, the formulator is in a position to compare formulations with regard to their flow-off behaviour during the formulation development or maintenance of a rinse aid, quickly and without great equipment expenditure. The flow-off behaviour can be correlated with the drying performance in the machine if suitable test conditions are selected. For example, the success of formulation modifications, the influence of the concentration of certain ingredients as well as the effect of different application conditions can be checked and estimated in advance without having to carry out elaborate machine tests at an early stage.

References:

[1] *Schirmer, W.; Altenschöpfer, T.; Wichelhaus, W.; Andree, H.* Prüfmethoden zur Bestimmung der Leistung von Klarspülern für das maschinelle Geschirrspülen Tenside Surf. Det. 1991, 28 (5), 313-319.

[2] *Rummler, B.; Stamminger, R.* A Physical Method for Measuring the Drying Performance in Household Dishwashers Tenside Surf. Det. 2009, 46 (1), 7-12.

[3] *Böhme, C.; Both, S.; Frischemeier, R.; Weuthen, M.* Maschinelle Geschirrreinigung – Entwicklung einer objektiven Messmethode zur Beurteilung der Klarspülleistung SÖFW Journal 2005 131 (10), 40-45.

[4] *Nerowski, B.; Höschler, B.* Auswertung der Klarspülleistung von maschinellen Geschirrspülmitteln durch die digitale Bildanalyse an gekrümmten Oberflächen SÖFW Journal 2007 133 (10), 48-52.

[5] Klarheit schaffen - Klarspüler test 2017 (10), 54-58.

author

Dr. Bastian R. Wulff
R&D / Innovation
Chemische Fabrik Dr. Weigert GmbH & Co. KG
Bastian.Wulff@drweigert.de

Care 360° – Solutions for Sustainable Life:
Verdessence is just one recent example of how BASF's Care Chemicals Division is addressing future challenges in sustainability, digitalization, innovation and new approaches to working together. → **care360.basf.com**

BASF
We create chemistry

Verdessence™

With our new Verdessence™ product line, we offer you biopolymer solutions for personal care, in line with the latest trends and designed to help you create even the most demanding cosmetic applications.

Get to know more at
personal-care.basf.com/verdessence

Modern Ready to Use Disinfecting Wipes – What You Need to Know

A. Bhattacharya, E. Cooban, J. Gromadecki, I. Naseer, E. Pambou, L. Woollen

Modern disinfectant-cleaner products are one part of the solution in addressing cross contamination and infection prevention in hygiene critical environments.

When choosing a disinfectant cleaner, a holistic view should be taken opposite all the product's attributes – antimicrobial efficacy is a critical aspect however, it is important to consider other product features like material compatibility, cleaning efficiency and ease of use.

In this article we will focus on one of the fastest growing product segments – disinfecting ready-to-use (RTU) wipes.

Modern, state of the art Disinfectant Cleaner RTU wipes for low level disinfection of hard surfaces are multifaceted products. These wipes offer efficacy against bacteria, yeasts and enveloped viruses combined with a spectrum of other important attributes ranging from fast contact times, one step disinfection and cleaning, delivery of very good surface aesthetics, broad and very good material compatibility, surface wetting for the recommended contact time, high quality substrates through to optimised cost-in-use. This article will explore the concept of effective, modern Disinfectant Cleaner RTU wipes.

Introduction

The need for appropriate and effective disinfectant technology has been widely recognised over time owing to infection outbreaks and more recently the COVID-19 pandemic that claimed *nearly 7 million lives worldwide* [1]. During the pandemic the importance of effective disinfectant technologies received heightened attention. More focus was given to enhanced cleaning and hygiene regimes to avoid cross contamination through high touch surfaces in domestic, and Industrial and Institutional (I&I) settings as well as improving overall personal hygiene and controlling hospital acquired infections (HAIs) within the health care segment [2].

Chemical disinfection followed by physical methods like UV light (UV – C) are major disinfection technologies prevalent in the market today. Among them chemical disinfection is typically a primary choice of disinfection mainly due to its ease of application and effectiveness including broad spectrum antimicrobial activity. Chemical disinfectants are available in the form of ready-to-use (RTU) and concentrate formats which are diluted prior to use and typically applied on large surfaces via mopping. Concentrates offer flexibility of disinfecting / disinfecting and cleaning large surface areas upon suitable dilutions. For smaller surfaces and high touch areas, RTU disinfectant and disinfectant cleaners (in the form of liquids and RTU wipes) offer convenience and ease of use. RTU wipes (also reported as pre-impregnated disinfecting RTU wipes, pre-saturated towelette and pre-wetted disinfecting RTU wipe in some literatures) are increasingly accepted for disinfection of high-touch surfaces because of their convenience, user friendly profile and reliable performance in domestic, I&I quick service restaurant and health care settings. With disinfectant cleaner wipes, end users can simply open the pack and start using them straight away for one step disinfection and cleaning. The practical convenience and efficacy achieved through RTU disinfectant cleaner wipes make them suitable for frequent use.

Post COVID, the maintenance of new hygiene norms requires facility providers/managers working in the I&I and healthcare segment to commit to thorough hygiene regimes – this takes time. Under time constraints, RTU disinfectant cleaner wipes offer quick cleaning and disinfection in one step saving time for users across domestic, I&I and health care segments.

Increased HAIs, the associated cost burden and increased hygiene awareness has raised the demand for frequent cleaning and disinfection of the high touch surfaces via rapid and efficient approaches. This change in perception of importance of hygiene has also created more demand for disinfectant cleaner RTU wipes in the market today. The surface disinfection RTU wipe market should reach USD 1.5 Billion by 2026 at a CAGR of 6.9% [3].

This paper discusses the complimentary attributes needed for an effective RTU disinfectant cleaner wipe that help address infection prevention in environments where high hygiene

standards are required but that also take into consideration the need for excellent cleaning performance and optimised in use costs. This paper also covers the growing market of RTU disinfectant wipes based on biodegradable substrates which are increasingly gaining attention due to sustainability goals and increased awareness around environmentally friendly products [4].

Selecting a good and effective RTU disinfectant cleaner wipe

Noticeably, cleaning and disinfecting products like RTU disinfectant cleaner wipes having specific performance attributes (both biocidal and non-biocidal) that deliver broad spectrum efficacy against pathogens, coupled with excellent cleaning performance and that are convenient to use are in more demand than ever. RTU disinfectant cleaner wipes are not only expected to deliver expected disinfection levels but should also provide good cleaning performance (as only properly cleaned surfaces can be effectively disinfected) and take equal care about surface aesthetics. Surface aesthetics (e.g., streaking, cleaning performance) as well as broad and good material compatibility are more and more important and becoming stronger product differentiators. However, there are increased cost pressures on the end user that need to be considered. Therefore, there is a need for a solution that delivers efficacy and non-biocidal performance all whilst considering optimised cost in use.

As discussed, microbial efficacy is a critical parameter for any disinfectant or disinfectant cleaner, including RTU wipes. In Europe, under the Biocidal Products Regulation (BPR) [5], to prove the efficacy against bacteria, yeast, and viruses – Phase 2 Step 1 (P2S1) & Phase 2 Step 2 (P2S2) tests should have been performed using the latest EN (European Norms) standards available. A RTU wipe that offers broad spectrum efficacy with a short contact time is always preferred but looking into the user's demand especially when undertaking thorough disinfection regimes is of prime importance. Especially in professional settings, the need for a high-frequency of disinfection and cleaning has increased tremendously and it becomes equally important to investigate the other key factors like one step cleaning and disinfection that save time; superior cleaning of biological and non-biological soils, long open pack shelf life (confirmed by efficacy tests), low streaking, low tackiness, wide coverage and low or negligible odour, all at a low cost in use.

Choice of substrate

The following criteria need to be considered when it comes to selecting a substrate for RTU disinfectant wipes:

1. Quality,
2. Liquor retention and wetting properties,
3. Absorption properties,
4. Feel,
5. Aesthetics,
6. Sustainability.

The quality of RTU wipes depends on the material of construction of the fabric (natural or synthetic), how the fibres in the fabric are interweaved and compressed (spun lace, spun bound or melt blown), it's area density in terms of gram per square meter (gsm) and thickness. The manufacture method also determines the wet pick up or liquor retention and wetting properties. RTU wipes used for disinfection are mostly made of non-woven textile materials, fabric that is made without using traditional methods of weaving or knitting fibre. Non-woven fabric can be of three types based on how it is made. It can be spun lace (used in RTU wipes), spun bound (used in carpet backing) or melt blown or thermo-bonded (used in diaper and feminine hygiene products).

Wipe weight and construction proves one of the most important factors for efficacy and cleaning. For a RTU wipe with preferred attributes a spun lace non-woven is used which is made by applying high-pressure water jets to one or more layers of fibre network at lower temperatures. The water pushes the fibres into a lace-like pattern. This non-woven composition is strong due to the irregularity of the fibre interlay and allows for higher weight wipe substrates to be formed with different textures and patterns. Spun lace non-woven fabric demonstrates higher absorbency rates, which makes it perfect to clean up spills and wetted organic debris. Also, the higher the absorbency of the wipe substrate the higher the amount of released disinfectant solution on the surface [6].

Based on the substrate used RTU wipes can be classified into two categories:

1. Synthetic RTU wipe and
2. Biodegradable RTU wipe

Synthetic RTU wipe substrates are the most common and cost effective option on the market today. They can be made up of polyester fibres (PET) or polypropylene (PP). PET is the synthetic material of choice for spun-lace wipes due to their better absorbency, softness and tensile strength. These RTU wipes provide high tensile strength, and good abrasion on the surface due to their high density. In general, they are more solvent resistant and offer lower cost in use. Biodegradable RTU wipe substrate on the other hand is more nature friendly as it is made of cellulosic fibres (cotton, viscose and lyocell). Cellulosic fibres provide good pickup of disinfectant liquid per gram of RTU wipe because their water retention rate is high. Although synthetic RTU wipes are dominating today there is an increasing inclination towards biodegradable RTU wipes as they offer a more eco-friendly option.

Choice of active / chemistry

Disinfectant RTU wipes show two-way action to remove the organic debris. They use the mechanical action of wiping and the disinfection activity of the disinfectant solution adsorbed on it. Inherent properties of the RTU wipe, such as fabric structure, fibre types, applied pressure, the number of passages and type of microorganism adhesion mechanism, determine the mechanical removal. However, transfer of microorganisms to other parts of the surface may still occur. During the wiping action some microorganisms could be just relocated to another place of the treated surface instead of being removed. To prevent unintentional transfer of microorganisms one should consider the retention and release of the disinfectant and also the spectrum of activity of the disinfectant that is adsorbed into the RTU wipe. Four factors mainly govern the efficacy of RTU wipes:

1. Type of active ingredients in the disinfectant solution to be used,
2. Amount of solution on the surface to be disinfected,
3. Concentration of active ingredient,
4. Amount of the solution remaining on the surface.

There is a wide variety of active chemical agents that can be used for disinfection. Among them alcohols, quaternary ammonium compounds and peroxygens are the most common ones in RTU wipes. The choice of active ingredient lies in the fact that it should have an efficacy profile which is adequate to needs, it needs to be approved as an active agent for biocidal use in the appropriate product type according to Biocidal Product Regulations (BPR) requirements, it should have proper material compatibility and the interaction of the active with the substrate should also be considered.

Alcohols (ethanol, isopropanol) are used for their efficient wetting and fast biocidal efficacy, but show limited material compatibility and therefore, alcohols are not suitable for the majority of plastics. They are not compatible with rubber as it induces deformity and makes the rubber and certain types of plastics hard over the period and highly inflammable. Alcohols show limited efficacy in the presence of organic matter (causing organic load fixation).

Chlorine, hypochlorite is the most common active agent. It is used for being low cost and for its fast mode of action and broad-spectrum efficacy. It is also unaffected by water hardness. However, above 500 ppm it is corrosive to metals and difficult to manage as it is irritating for, eyes, mucous

membranes, and skin. Other disadvantages are that it can discolour and bleach user's clothing. Most importantly, it reacts with ammonia or acid and generate toxic chlorine gas.

Hydrogen peroxide offers a germicidal activity and is a known sporicidal agent with longer contact time. It degrades quickly into H_2 and O_2 therefore presents a very eco-friendly disinfectant. It does not produce residues and is very efficient even in the presence of organic matter. The limitation of hydrogen peroxide is that it is unstable in dilution and is corrosive to copper, plain steel, and galvanized iron, brass, bronze.

A widely used chemistry for disinfectants RTU wipes is based on Quaternary Ammonium Compounds (QACs), this chemistry is a good alternative to alcohol, bleach based or H_2O_2 based RTU wipes. QACs can be mono-alkyl quats or di-alkyl quats. QACs possess good cleaning and deodorization properties and a relatively broad spectrum of efficacy including bacteria, yeasts, and viruses (lipid, enveloped viruses. Di alkyl QACs (DDAC (C8-10) or DDAC (C10-10)) are always preferred QAC choices because they are less affected by anionic species, organic matter and have low odour. DDAC (Didecyl Dimethyl Ammonium Chloride) also shows a better efficacy profile in comparison with ADBAC (Alkyl Dimethyl Benzyl Ammonium Chloride).

Choice of test method for efficacy

It is important to understand which methods are applied to prove efficacy of both biodegradable and synthetic RTU wipes. A disinfectant RTU wipe tested with wrong EN standards poses non-compliance as well as a threat to users. As discussed earlier, RTU wipes that have been tested as per latest EN standards provide a high level of confidence for their efficacy.

Efficacy claims are substantiated by testing products in appropriate standard methods – EN norms – simulating practical use conditions.

Phase 2 Step 1 (suspension) and Phase 2 Step 2 (surface or carrier) tests are required to determine the effective dose of a product in a defined application area e.g. I&I or healthcare. There are several parameters that influence the performance of a product in the EN norms required to support claims against target organisms. Temperature, soiling, contact time and log reduction all influence the pass level and ultimately the claim. Soiling levels determine whether claims may be made for a disinfectant or a disinfectant cleaner with low-level soiling supporting a disinfectant application and high-level soiling supporting a disinfectant cleaner application.

Test method	Organism	Application area	Conditions	EN standard
Phase 2 step 1	Bacteria	Healthcare	Clean or Dirty	EN 13727:2012 +A2 2015
Phase 2 step 1	Bacteria	I&I	Clean or Dirty	EN 1276:2019
Phase 2 step 1	Yeast	Healthcare	Clean or Dirty	EN13624:2021
Phase 2 step 1	Yeast	I&I	Clean or Dirty	EN 1650:2019
Phase 2 Step 2	Bacteria/Yeast	Healthcare /I&I*	Clean or Dirty	EN16615:2015 (Mechanical action on non-porous surfaces)

* EN 16615 is a standard in the Healthcare area, there is not an equivalent I&I standard with mechanical action, therefore this standard can be modified to reflect the organisms and soiling conditions required to support an I&I claim

Tab. 1 EN efficacy standards for RTU wipes

Bactericidal and yeasticidal efficacy is a "must have" for most applications. Appropriate standards to test this efficacy are described in **Table 1**.

It is important to note that as per the updated regulatory requirements under the Biocidal Product Regulation (BPR), EN16615:2015 should be used as the Phase 2 Step 2 test to substantiate bactericidal and yeasticidal claims where mechanical action is employed on non-porous surfaces. The efficacy of the RTU wipe is evaluated based on the number of live organisms remaining on the surface after the mechanical action.

Virucidal claims can also be substantiated using the same testing approach of Phase 2 Step 1 and Phase 2 Step 2 EN norms. Currently there are only virucidal norms in healthcare but they can be adapted to accommodate other application areas. EN 14476 2013:+A2:2019 is the Phase 2 Step 1 test that is employed, modified where required; there is however no published Phase 2 Step 2 method for virucidal testing. EN 16615 may. be modified to incorporate the use of viruses to support a mechanical action claim, to reflect how the product will be used in practice. Suspension data should preferably be generated on liquid extracted from the pre-impregnated wipe. This is particularly important as in some cases binding between the active substance and non – woven fibres may be observed which impacts efficacy.

Non-biocidal performance

For an ideal RTU disinfectant cleaner wipe, non-biocidal properties like cleaning efficiency streaking and tackiness caused by residues left on surfaces after wiping, and compatibility with surfaces are also equally important.

The wipes should be able to cover large surface area without compromising on efficacy to keep the cost in use as low as possible. Surfaces of a known area are treated with the wipe test product. The wipe coverage is counted as the total area covered which can remain wet for the duration of the contact time of the wipe. It is especially important that a surface treated with the wipe should stay wet for the recommended contact time to provide expected efficacy.

To determine cleaning efficacy of a wipe, the experimental design plays a crucial role. The experiment should mimic real use conditions, with appropriate selection of soils for those encountered in healthcare and I&I set ups. In addition to cleaning, aesthetic properties like surface streaking and tackiness need to be considered. Not only should a wipe provide excellent cleaning, but it should leave low residues behind, to deliver a low streak and low tack finish on the treated surface. A RTU wipe should be thoroughly tested to demonstrate compatibility with commonly used surfaces like metals (Aluminium & Stainless Steel), and plastics (Acrylonitrile Butadiene Styrene (ABS), Polycarbonate, Polyoxymethylene (POM), Polyoxymethylene (POM) Natural, Polyvinyl Chloride (PVC) and Polystyrene). RTU wipes based on Di-alkyl Quat (DDAC (C8-10) or DDAC (C10-10)) offer an excellent choice for disinfection of alcohol sensitive surfaces.

Open Pack Efficacy

How the RTU disinfectant wipes are packed in final packaging is also critical to consider but often overlooked as part of maintaining a good cleaning regime. A pack of wipes are available in various units starting anywhere from 30 to 200 units per pack. These packs are opened and resealed multiple times throughout the course of use. Resealable pack of wipes should be thoroughly tested, and it should be ensured the wipes do not dry out and remain efficacious for a specific period after opening. Good practice is for manufacturers to confirm the open-pack efficacy at the end of a specified period after opening with a 4-field test.

Conclusion

RTU Disinfectant Cleaner products offer benefits of convenience, time saving, and ease of use for disinfecting small surface areas in I&I and health care settings. RTU disinfectant cleaner wipes are considered as a step forward offering in this space as they offer already impregnated solution on wipes in prewetted format. As their demand is growing, it is expected that a RTU wipe should deliver the desired efficacy against pathogens and at the same time should not alter surface aesthetics yet remain low cost in use. It should hold a strong position in the regulatory landscape and open sustainabili-

who has superhero beauty protection?

phyteq™ raspberry one
multifunctional

Ashland's innovative phyteq™ raspberry multifunctional single active is globally recognized for its outstanding skin benefits. With phyteq™ raspberry one multifunctional Ashland now launched a synergistic, easy-to-use liquid blend, that offers broad spectrum efficacy across a wide pH range. Even in difficult to protect formulations it delivers excellent performance. Additionally, this all-in-one product provides remarkable antioxidant and well-aging properties that help to care for the demanding skin. Formulate for healthier skin and well-protected cosmetics with phyteq™ raspberry one multifunctional. For more information or to request a sample, visit **ashland.com/phyteqraspberryone**

ashland.com / efficacy usability allure integrity profitability™

Ashland™
always solving

ty options for the customers. As we see increasing pressure on single use plastic wipes, biodegradable RTU wipes open a hope for contributing towards sustainability goals. To achieve the expected product profile, a combination of the right quality non-woven substrate and chemistry delivering the expected efficacy (as per the relevant EN standard) with desired aesthetics and feel, wetting properties and liquor retention for the desired period in the open pack is important. As the disinfectant wipe market matures, we expect to see a sharp increase in the demand of sustainable RTU wipes that have been designed giving equal value to their efficacy profile and non-biocidal parameters (that take care of the surface applied on), under the complex and dynamic regulatory landscape.

For customers who are looking to add a BPR ready disinfectant – cleaner wipe product to their portfolio, they should investigate available RTU wipes options keeping following aspects in mind:

1. Options that enable fast market entry but saving time and cost associated with new product development.
2. Cost and time saving benefits through aligning to a product that will have a registration footprint (with supporting data package) under the Transitional Arrangements of the BPR.
3. Reduced time allocation needed for regulatory compliance by aligning with a product that will have an existing Regulatory Registration
4. Cost effective sub-registration approach for potential future EU (European Union) Biocidal Products Regulation (BPR)
5. Savings in supply chain / procurement / manufacture by purchasing ready formulated concentrate to reduce need for additional suppliers of raw material, raw materials blending, and logistics.

References:

[1] Mortality Analyses - Johns Hopkins Coronavirus Resource Center (jhu.edu)

[2] Beyond theatre: The demand for cleanliness post-COVID-19 | Mintel

[3] Markets and Markets: Surface Disinfectant Market Global Forecast to 2026, December 2021, pp40, pp41, pp78, pp 79, pp81, pp84

[4] https://www.aldipresscentre.co.uk/business-news/aldi-commits-to-only-selling-plastic-free-wipes/

[5] Biocidal Products Regulation (EU) No 528/2012

[6] *Song, X., Vossebein, L. & Zille, A.* Efficacy of disinfectant-impregnated wipes used for surface disinfection in hospitals: a review. Antimicrob Resist Infect Control 8, 139 (2019).

authors

Amit Bhattacharya, Emma Cooban, Jędrzej Gromadecki, Iram Naseer, Elias Pambou, Lorraine Woollen
Arxada

Corresponding Author: Amit Bhattacharya
amit.bhattacharya@arxada.com

Vantage®

Natural Beauty Ingredients

- FermBiotic™ Active Ingredients
- Jeechem™ Silicone Alternatives
- Textron™ Upcycled Natural Oils
- Metaupon™ Sulfate-Free Surfactants

MEET US
at Sepawa
Booth
#C412-414

Customizable Cleaning Solutions

- Leunapon™ Low-Foaming Surfactants
- Lumisolve™ Foam Booster
- Leunapon™ Cleaning Agents
- EU Ecolabel Suitable Ingredients

Vantage Leuna GmbH
Am Haupttor, Gebäude 7302
06237 Leuna
Tel: +49 (0) 3461 43 43 87
Mail: leuna@vantagegrp.com

www.vantage-leuna.de
www.vantagegrp.com

Multifunctionals as Innovative Solutions for Formulating Modern Home Care Products

T. Bartolini, M. Ortega

Introduction

For decades, Symrise has been at the forefront of successfully developing and marketing innovative and versatile ingredients as well as cutting-edge technologies to accommodate challenging consumer, regulatory, and formulator needs. Irrespective of whether it is personal care or home care, the market requirements are ever-increasing and demand smart ingredients that fit today's modern and advanced product formats.

The world of multifunctionals has always been a key area of investment at Symrise. Understanding the huge potential of solutions that serve a wide range of purposes has facilitated some of the industry's most exciting success stories. Ongoing innovation enabled numerous smart ingredient launches to cater to even the most demanding product concept or regulatory restriction. Symrise is now building on this expertise to develop innovative solutions for household products.

The three main pillars of multifunctional ingredients at Symrise are based on the key features of innovation, expertise, and sustainability. Those high standards apply to the newly created portfolio of multifunctional ingredients dedicated to home care products. The multi-talented materials reduce the impact on the environment, improve cleaning performances, and product aesthetics as well as enhance the formulation integrity of products such as laundry, dishwashing, and surface care detergents.

Symrise's global network of experienced teams, including regulatory experts and state-of-the-art laboratories, enables the company to expand its traditional business activities beyond cosmetic applications and into the world of household cleaners. The recently inaugurated Beauty & Home Care Center of Expertise near Paris houses dedicated facilities specifically focusing on developing and testing home care formulations and applications. Having their specific needs and regulations, Symrise is well experienced and equipped to fully support challenging requirements for cleaning and household applications.

Sustainability is a significant part of the corporate strategy which is reflected in the numerous biodegradable and bio-based ingredients that form the Symrise portfolio— and it doesn't stop there. The entire value chain is based on these principles and includes the responsible cultivation and end of life of key raw materials, innovative product development, trusted partners and suppliers, and continuous optimization of manufacturing processes.

Ongoing investment in innovation backed up by extensive consumer and market insights allows Symrise to develop new suitable solutions to the evolving challenges and demands of the personal and home care market. This is done by researching new chemistries but also discovering additional benefits for established ingredients. As a renowned scientific leader in the industry, Symrise's global research centers develop avant-garde ingredients based on comprehensive testing methods for innovative claim substantiation.

Consumer trends come and go but what is here to stay is the overwhelming and unifying need to protect our planet for future generations. Consumers have changed their habits of consumption and are critically questioning the need for long ingredient lists as well as the necessity for non-sustainable or non-biodegradable materials. Therefore, the demand for high-performance environmentally friendly cleaning agents is growing immensely.

Importance of Multifunctional Ingredients

Multifunctional product formats have been around for some time. In 1987, Procter & Gamble introduced the first "2 in 1" shampoos and conditioners. This can be considered as the beginning of an ever-increasing demand for new combinations of functionalities in personal care products that require smart multi-tasking ingredients able to deliver several benefits to keep the ingredient lists short.

Multifunctionals have proven repeatedly how future-oriented and versatile this product category is. As part of the 'less is more' movement, ingredient solutions that satisfy several formulation or consumer needs rank very high, for obvious reasons. The concept of minimalism is about avoiding the unnecessary and suggests for formulations, that single ingredients

can perform more than one function, consequently reducing the number of used materials.

Consuming less and consuming better has become mainstream and can only be expected to grow even more in the future. More sophisticated and educated consumers make conscious shopping decisions by investigating ingredient lists and corporate values. Aspects that are important in this context are environmentalism, transparency, sustainability, biodegradability, product safety, and effectiveness.

Fulfilling all these above aspects, the Symrise home care multifunctionals have been tailored to satisfy a whole catalog of requirements from stabilizing formulations improving cleaning performance, enhancing sensorial aspects, and product aesthetics.

Application of Multifunctionals to Home Care Products

The global trend of sustainability and transparency is not only relevant for skin and hair care products but has already spilled vastly into the world of household cleaners. Consumers expect companies to comply with increasingly strict sustainability standards, demanding safe and effective products with fewer ingredients but the same high quality.

This puts brands under pressure as many traditional ingredients used in home cleaning products will probably not meet further stringent requirements anymore. Increasing regulatory restrictions, evolving consumer demands and limited ingredients choice add to this pressure. This is why Symrise has decided to invest in the research and development of sophisticated and advanced multifunctional ingredients dedicated to the specific needs and requirements of home care applications.

The recently launched range consists of multifunctional ingredients that have a lower carbon footprint and are biodegradable in both aerobic and anaerobic conditions. This innovative technology can be suitable for the EU ECOLABEL and for ECOCERT certification for detergents.

From a functional perspective, the ingredients improve the grease removal strength of home care products thus increasing their overall cleaning power. This criterion has become more important in recent years. The multifunctional ingredients of Symrise also provide a solution for maintaining the integrity of the formulation since they keep important ingredients, such as enzymes, stable. Furthermore, the new multifunctionals provide antioxidant activities, optimized solubilization properties as well as foam density and stability-enhancing benefits. This will result in better scent and sensory performance as well as an improvement in the long-lastingness of the finished products.

In this article, we will present two different types of multifunctional ingredients: polyols and ketone derivatives. As an overview of their wide range of benefits in household products, the purpose is to demonstrate their ability to maintain the finished product stability for a longer time and improve the cleaning performance as well as the sensory experience.

Product Stabilization

Enzyme Stability

In this study, the starch removal power was evaluated with a typical hand dishwashing detergent (HDW – pH 5.5 – surfactant system SLES sodium lauryl ether sulfate and CAPB cocamidopropyl betaine) containing commercial amylase at 0.05%. The HDW/amylase was compared to HDW/amylase containing ketone derivative (Fioflex™ 4H) at 0.5% **(Figure 1)**.

Mixed starch soils (CFT DM377) treated with HDW/amylase and HDW/amylase with ketone derivative were soaked for 1h at 35°C.

Panel evaluation of soil removal was performed (T0). HDW/amylase and HDW/amylase with ketone derivative were stored at 40°C for 1 month. The experiment was performed once again followed by panel evaluation (T1). The rating scale was from 0 (no removal) to 10 (totally cleaned).

At T0, the cleaning efficacy was rated very high with the HDW/amylase detergent (8: very cleaned), a similar result was obtained with the HDW/amylase and ketone derivative detergent (8: very cleaned).

At T1 (1 month at 40°C storage), a decrease in cleaning efficacy was observed with the HDW/amylase detergent (1: very low removal) but the cleaning efficacy was still high with HDW/amylase and ketone derivative detergent (6: cleaned).

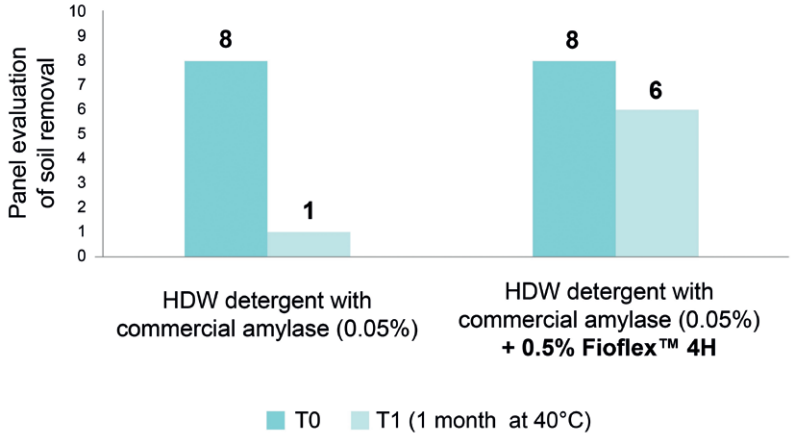


Fig. 1 Enzyme stability

Ketone derivative in HDW/amylase detergent helps to maintain enzyme stability and prolong the product performance over time.

Product Integrity

Challenge tests were performed using *Candida albicans* (ATCC 10231), *Aspergillus brasiliensis* (ATCC 16404), *Escherichia coli* (ATCC 8739), *Pseudomonas aeruginosa* (ATCC 9027), and *Staphylococcus aureus* (ATCC 6538).

A hand dishwashing detergent containing 1.0% polyol (Yesteem™ 65)/0.4% sodium benzoate and a glass cleaner containing 0.3% ketone derivative (Fioflex™ 4H)/0.7% phenoxyethanol were tested. Samples were inoculated, and the 0-hour assay was performed. Samples were stored in a 20-25°C incubator. At 2, 7, 14, and 28 days after inoculation, the samples were removed from the incubator and assayed for surviving organisms **(Figure 2)**.

In HDW and glass cleaner, polyols and ketone derivatives combined with a preservative system showed a significant reduction of microorganism levels after 28 days.

In different formula types, polyols and ketone derivatives help to maintain product integrity over time.

Cleaning Performance

Degreasing

In this study, the degreasing power (neat) of a typical degreaser formulation (pH 10.5) was compared with a formula containing 1% polyol (Yesteem™ 85).

Fatty soil with added carbon black soils (CFT DM40) was treated with a typical degreaser or a degreaser containing 1% polyol. The test was performed using an abrasimeter, 70 scrubs were done with a 160g load. Panel evaluation of soil removal was conducted. The rating scale was from 0 (no removal) to 10 (totally cleaned) **(Figure 3)**.

The degreasing power was rated low with a typical degreaser (3: low removal). In contrast, the formula containing 1% polyol demonstrated a very high degreasing power (8: very cleaned).

Polyols help to remove easily and effectively greasy soil to achieve a better cleaning performance. As a co-surfactant, it offers the opportunity to reduce surfactant content.

Sensory Experience

Foaming

A Suds Mileage test was performed and the efficiency of a hand dishwashing detergent (HDW – pH 5.5 – surfactant system SLES sodium lauryl ether sulfate and CAPB cocamidopropyl betaine) was measured through the stability of its foam under the action of a representative mixed soil containing lipids, proteins, and carbohydrates (STIWA II).

The soil was coated onto the center of a plate using an automatic dispenser. HDW and HDW containing 0.5% polyol (Yesteem™ 60 or Yesteem™ 65) were added to a washing-up bowl containing 5 liters of water maintained at 45°C. The number of plates washed up until the foam collapsed was counted and compared between HDW and HDW containing polyol **(Figure 4)**.

The HDW detergent containing polyol showed a better foam density and aspect in comparison with the HDW detergent alone. Moreover, the number of washed plates until full foam collapse was higher with the HDW containing polyol (28) compared with HDW (23) alone. The increase is about 22%.

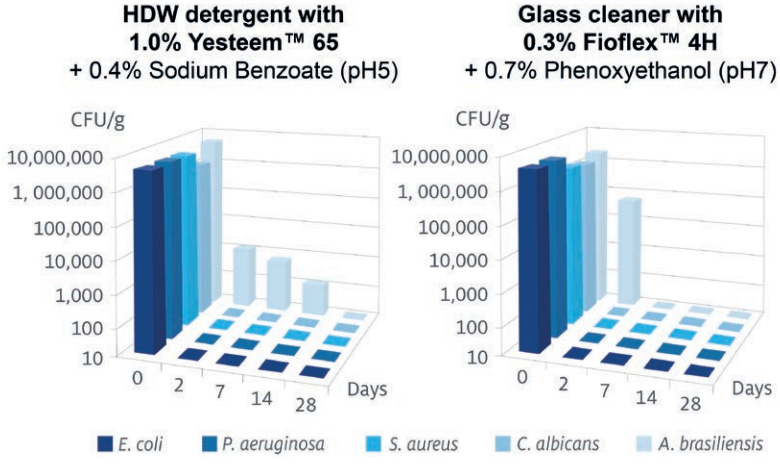


Fig. 2 Product integrity

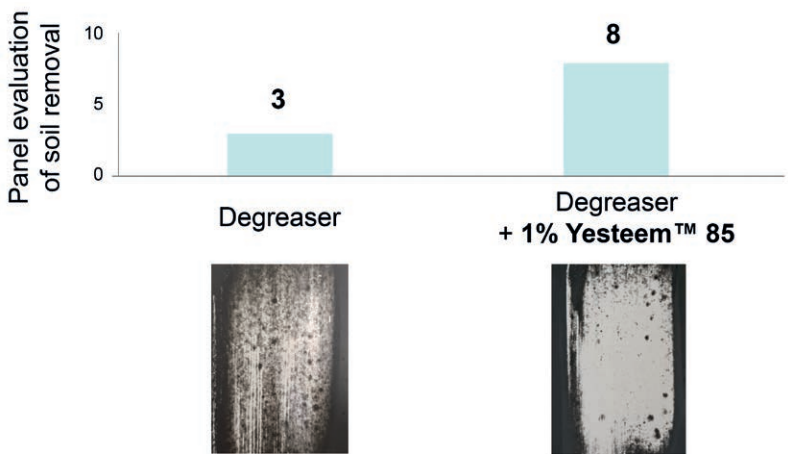


Fig. 3 Degreasing power

Polyols modulate foam density and aspect while allowing its long-lastingness. As a co-surfactant, they offer the opportunity to reduce surfactant content.

Conclusion

As multifunctional ingredients, polyols and ketone derivatives offer a wide range of benefits to cleaning products. Their abilities to stabilize enzymes and maintain product integrity help to strengthen the formulation and prolong its performance. The enhanced foaming power allows the long-lastingness of the cleaning product and even offers the possibility to reduce the content of surfactants. This clearly contributes to a better sensory experience. Additionally, polyols were shown to effectively increase the overall cleaning performance of home care products.

In summary, Symrise's new range of multifunctional ingredients for home care applications is a great choice to help formulators develop modern cleaning products with high efficacy and lower carbon footprint. They offer great potential for the next generation of home care cleaners that aims to not only improve the general well-being and health of our families by ensuring a clean home but also give consumers peace of mind by reducing the environmental impact.

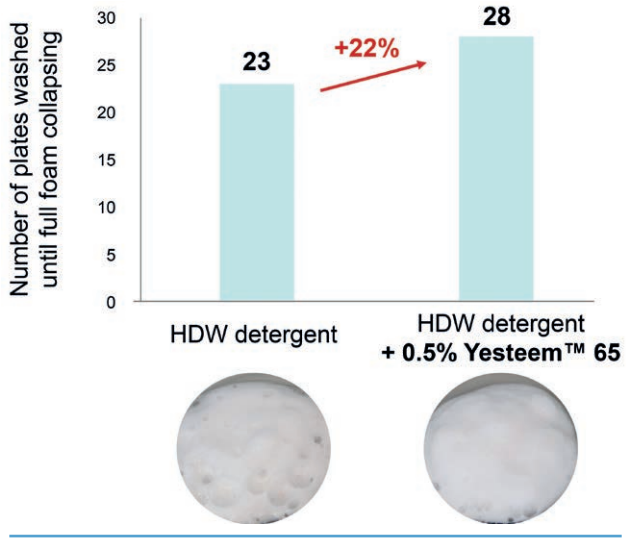


Fig. 4 Foaming

authors

Tony Bartolini, Global Category Director Home Care
Marine Ortega, Marketing Project Manager
Symrise AG | Mühlenfeldstrasse 1 | **37603 Holzminden** | **Germany**
homecare-ci@symrise.com

Determination of Surface Tension of Surfactant Solutions from a Regulatory Perspective

J. Venzmer

abstract

Determining the surface tension of surfactant solutions sounds simple, and the state of the art for decades has been Pendant Drop Tensiometry (Drop Shape Analysis). According to DIN/EN/ISO standards and OECD guidelines, the only legally existing methods in the field of surfactants are the ring/plate methods, basically from the pre-computer era. For many technical surfactants and especially for surface-active polymers, these vintage methods have serious technical shortcomings caused by an inherently uncontrolled surface age. This will be demonstrated by discussing the surface tension results of two associative thickeners. Normalization activities have been initiated to „legalize" the current state of the art, Pendant Drop Tensiometry, also in the field of surfactants.

Introduction

The determination of surface tension of aqueous solutions is one of the most fundamental physicochemical characterizations of any surfactant molecule. Different methods are used depending on the time scale of surface tension reduction relevant for the specific application: Wilhelmy plate [1], du Noüy ring [2,3] or Drop Shape Analysis (Pendant Drop Tensiometry) [4,5] for slow processes or equilibrium values, or the Maximum Bubble Pressure method [6] for dynamic surface tensions, which is more relevant for fast wetting processes such as printing. For regulatory purposes, the (static) surface tension of a 0.5% aqueous solution/mixture is required for both the Customs Tariff Regulation [7] and the EU Detergent Regulation [8,9]; in addition, the Critical Micelle Concentration (CMC; derived from the determination of surface tension as a function of concentration) [10] is often used to calculate the octanol/water partition coefficient log K_{ow} [11]. None of these regulations specify which method should be used to measure surface tension. The only "official" methods, according to OECD Technical Guideline 115 [12], are the "vintage" (>100 years old) ring/plate methods as described in ISO [13] and EN [14] standards, which basically date from the pre-computer era. During the discussions on the upcoming regulation on Polymers&REACh, it was recognized by several parties [15] that guidance is needed on how to identify surface active polymers, as surface activity will most likely be one of the grouping criteria of Polymers Requiring Registration (PRR) [16]. Obviously, any classification of polymers as being surface-active should be based on their properties and not on shortcomings of the analytical methods. Unfortunately, the ring/plate methods (i.e. the only "legally existing" ones) have a serious technical deficiency, especially for technical surfactants and surface-active polymers.

History – Wilhelmy and du Noüy

A general feature of the ring/plate method is that the surface age of the air/water interface of the surfactant solutions is poorly defined. This may not be a problem for hydrophilic, well water-soluble, high purity, low molecular weight surfactants, as they are mostly used in academic studies. In the case of "normal" (to avoid the term "technical") surfactants with alkyl chain distributions (e.g. coco = C8 – C18), the presence of the more hydrophobic components can be quite problematic for performing surface tension measurements; the same is true for solutions of surface-active polymers. Once a more hydrophobic fraction of the sample material or an impurity (e.g. processing aid, educt, residual fatty acid in an ester-based product) has found its way to the air/water interface, it will dominate the measurement and prevents the determination of the surface activity of the substance intended to be analyzed.

One fairly obvious example of this general shortcoming of these two methods is the "reverse" method for determining CMC [10]. Here, the determination of the surface tension as a function of concentration starts with a concentrated surfactant solution that is gradually diluted. The practical advantage is that the titration equipment only needs to be filled with water, which eliminates the need to clean the equipment. However, this ease of handling comes at the expense of data quality: Any small fraction of a more hydrophobic component that has found its way to the surface at high concentrations will not leave the surface upon dilution below CMC – there is no real equilibrium between the molecules at the air/water interface and those dispersed in the subphase. Therefore, the measured surface tension is much lower than the "real" value of the corresponding pure surfactant.

State of the art: Drop Shape Analysis

Advances in image processing and computing power over the past three decades have made Drop Shape Analysis a well-established method; corresponding Pendant Drop Tensiometers are commercially available from several companies. Since a new drop is formed for each measurement, the surface age is well defined and it is even possible to follow the kinetics of surface tension reduction. This is one of the reasons why Drop Shape Analysis (Pendant Drop Tensiometry) has been the state of the art in surface tension measurement for decades in both academic and industrial laboratories. Unfortunately, this progress has not yet found its way into surfactant-related standardization; the current activities of the relevant standardization groups are outlined below.

Solubility in water as prerequisite

Any determination of surface tension, including Drop Shape Analysis, only makes sense for water-soluble products – unless the substances are liquid themselves and the surface tension of the bulk material is of interest. Therefore, dissolution tests have to be carried out before a surface tension measurement can be started. It is also necessary to decide which concentration to use for the measurement. According to OECD TG 115 [12] on the determination of surface tension, the concentration to be used should be 90% of the saturation solubility, but not more than 1 g/L. For most surfactants, this is above the Critical Micelle Concentration (CMC), but there is no such thing as a saturation limit for surfactants – the only exception: Ionic surfactants below the Krafft temperature [17]. Ideally, some guidance on solubility should be found in the relevant OECD technical guidelines. The guidelines 105 and 120 [18,19] are, however, not helpful when it comes to surfactants and surface-active polymers; this topic is being discussed in a separate paper in this volume [20].

The best option, and most probably the only one that provides clear guidance, would be to perform the surface tension measurements for grouping purposes at a defined concentration; whether this should be 1 g/L (as in the current OECD TG 115 [12]) or 5 g/L (as in the Customs Tariff [7] as well as the Detergent Regulation [8,9]) could still be debated. Ideally, the sample should be completely homogeneous and dissolved in order to avoid artifacts which do not allow conclusions to be drawn about the substance (e.g. polymer) under investigation. Complete solubility, however, is not required for the

Customs Tariff classification, where it is accepted that the material may form an emulsion, as long as there is no separation of insoluble matter. This is conceptually difficult, as an emulsion is inherently unstable; moreover, there is no guidance given in the regulation on how to experimentally assess the absence of "separation of insoluble matter" in an emulsion.

Determination of Critical Micelle Concentration (CMC)

For regulatory purposes, the CMC is often considered a valuable parameter of a surfactant, e.g. to calculate log K_{ow} [11]. However, from an application perspective, the relevance of CMC values for the formulator is rather limited; they are only useful for people working with single surfactants in distilled water. There are also some challenges when taking the only existing standard for determining CMCs (ISO 4311:1979 [21]) seriously. A determination of CMCs by measuring surface tension as a function of concentration is straightforward for super-pure surfactants used in academia, but as soon as there are alkyl chain distributions or a distribution of homologues e.g. in the case of ethoxylates with different degrees of ethoxylation, the surface tension vs. concentration plots do not show the characteristic kink as in case of the super-pure surfactants, but a more or less smooth curve[10]. An example of the effect of an alkyl chain distribution in alkylamidopropyl betaines is shown in **Figure 1**: Pure C12 (■) vs. Coco (□). The ISO norm 4311 explicitly states that if a CMC curve looks like the one for CAPB (□), "experimentally no value for the range of c.m.c. can be defined". This part of the standard is usually completely ignored, as there is no other option.

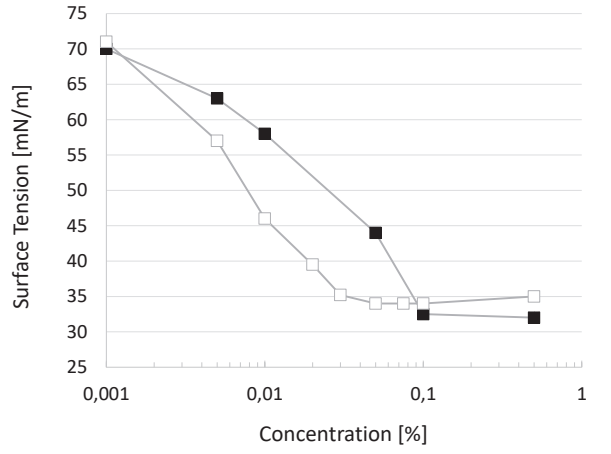


Fig. 1 Surface tension of Cocamidopropyl betaine (□) and Lauramidopropyl betaine (■) as a function of concentration (DataPhysics OCA 25, static values at 600s)

Interpretation of the surface tension results

The current OECD TG 115 [12] does not provide guidance on how to interpret the surface tension data obtained. According to the REACh regulation [22], substances with a surface tension of <60 mN/m at a concentration of 1 g/L should be considered as surface-active materials. This statement on page 56 (of 739) surprised many physical chemists, because from an application perspective, surface-active substances (= surfactants) typically have surface tensions of about 25-35 mN/m. Accordingly, both the Customs Tariff [7] and the EU Detergent Regulation [9] use a limit of <45 mN/m at a concentration of 0.5%. This value is already quite conservative considering the application performance (i.e. ability to solubilize, wash, clean), but it does make sense from a hazard assessment point of view: It has been shown that surfactants can only interact with lipid membranes if their surface pressure is >25 mN/m, which corresponds to a surface tension of <47 mN/m (surface tension of water (72 mN/m) minus surface pressure of the surfactant solution = surface tension of the surfactant solution) [23]. The reason for proposing a surface tension limit as a grouping criterion for PRR is that surface activity should allow prediction of the (eco)toxicological potential of the polymer, i.e. the possibility of interaction with biological material. This correlation is only given by using the <45 mN/m instead of the <60 mN/m criterion. In fact, it does not take much to reduce the surface tension of water. For example, polyethylene oxide (PEO) is purely water soluble and non-amphiphilic, but nonetheless it reduces the surface tension of water – depending on concentration and molecular weight – down to values even below 50 mN/m [24]. Such a polymer, which does not carry any hydrophobic residues, has no tendency to interact with hydrophobic substances or membranes and therefore should not be included in the category of surface-active materials.

Examples: Associative thickeners

To put this mostly theoretical discussion into practice, we have chosen associative thickeners as an example of amphiphilic polymers: Ethoxylates with a molecular weight of several thousand Daltons, esterified with at least two long chain fatty acids. The structurally simplest associative thickener is PEG-150 Distearate (INCI), which is PEO of MW 6000, esterified at both ends with stearic acid. In order for PEG-150 Distearate to function as an associative thickener, i.e. to bridge surfactant aggregates, it is necessary to ensure that the PEO is esterified at both ends, and therefore – to achieve this during synthesis in a reasonable amount of time – a slight excess of fatty acid is used in the esterification. Consequently, the final product contains some residual stearic acid (salt, depending on the pH of the solution), i.e. soap.

When it comes to determining the surface tension of a solution of such a polymer containing hydrophobic, surface-active impurities (such as residual fatty acid), there is the more or less philosophical question of whether to determine the surface activity of the polymer itself, or that of the product including the impurities. There are two options to determine the surface tension of a solution of the "pure" polymer: Either purify the polymer to remove the low molecular weight surface-active

SUMMIT
COSMETICS

EUROPEAN DISTRIBUTOR OF COSMETIC INGREDIENTS

Active Ingredients

Natural Scrubs

Vitamins & Pure Molecules

Castor Oil Derivatives

Natural Multifunctionals

Thickening Biopolymers

Solvents & UV Filters

Summit Cosmetics Europe
German Branch
Schwannstr. 10, 40476 Düsseldorf, Germany
contact-germany@summitcosmetics-europe.com
+49 (0)211 4570 511

summitcosmetics-europe.com

Join us at
SEPAWA® CONGRESS
BOOTH E736-737

components (if this is possible), or perform the measurement using a method and/or under conditions where the impurities do not dominate the result; in the case of long-chain fatty acids, this means using the Pendant Drop method and choosing a pH value at which the fatty acid is soluble (rather than being protonated, insoluble and with an even stronger tendency to adsorb at the air/water interface).

PEG-150 Distearate presents an additional challenge: since both hydroxyl end groups of PEG-150 are esterified, this model associative thickener lacks sufficient hydrophilicity, and in combination with the readily crystallizable octadecyl chains, PEG-150 Distearate is not clearly soluble in water (without the addition of other surfactants): some "shimmer" (crystalline aggregates) is visible. This presents a challenge when determining the surface tension of aqueous solutions of this amphiphilic polymer. Using the du Noüy ring method, measurements were hardly possible, because the liquid lamella often broke during the measurement – most likely due to the presence of the crystals in the solution. The Wilhelmy plate method gave for both concentrations (0.1 and 0.5%) surface tensions of about 35 mN/m (pH 4) and 31 mN/m (pH 8); it seems like the soluble sodium stearate was more surface-active – at least at higher surface ages – than the protonated stearic acid. The Pendant Drop method provides more insight into the situation, as shown in **Figure 2**. The two solutions at the lower concentration (0.1wt%; open symbols) start with higher surface tension values at short drop lifetimes, which is to be expected since less surfactant is available to populate the freshly formed drop surface. However, the plateau values at longer drop ages are somewhat lower at pH 4 (△,▲) than at pH 8 (□), except at the highest concentration (■): The second step (after a drop age of about 100 s) is very atypical and most likely an artifact caused by the presence of the "shimmering" crystals. This shows that the process of sample preparation, including heating to melt and better disperse the material, followed by stirring during cooling and crystallization, has an influence on the measurement, in case a material does not form a clear solution. However, the aim is to obtain information about the substance itself and not about the effect of the presence of some crystals. It can be concluded that the surface tension of solutions of PEG-150 Distearate is >45 mN/m, and therefore this polymer should not be classified as surface-active. This is not unexpected, since an effective reduction of surface tension requires a more or less close packing of alkyl chains at the air/water interface – which is challenging because (A) each alkyl chain carries (on average) a headgroup of 75 EO and (B) there is also some steric hindrance because the alkyl tails are present as pairs linked by PEG-150.

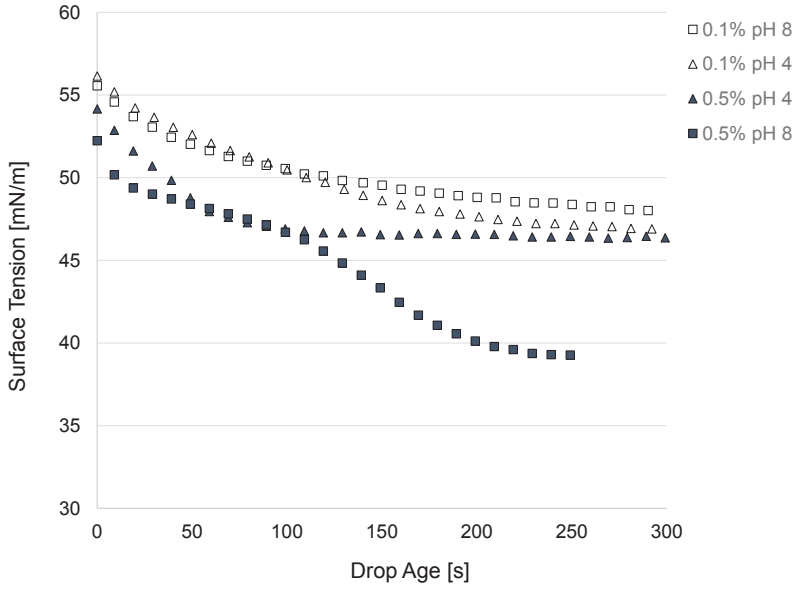


Fig. 2 Surface tension as a function of drop lifetime of 0.1% (open symbols) and 0.5% (closed symbols) aqueous solutions of PEG-150 Distearate using the Pendant Drop Method (DataPhysics OCA 25) at pH 4 (△,▲) and pH 8 (□,■)

The second example is a more hydrophilic, clearly water-soluble associative thickener: PEG-120 Methyl Glucose Dioleate. Methyl glucose has four hydroxyl groups that are ethoxylated by a total of 120 EO, and at least two of the four hydrophilic arms are esterified with oleic acid. The results of the surface tension measurements using the Pendant Drop method are shown in **Figure 3**. This time, the results look as expected,

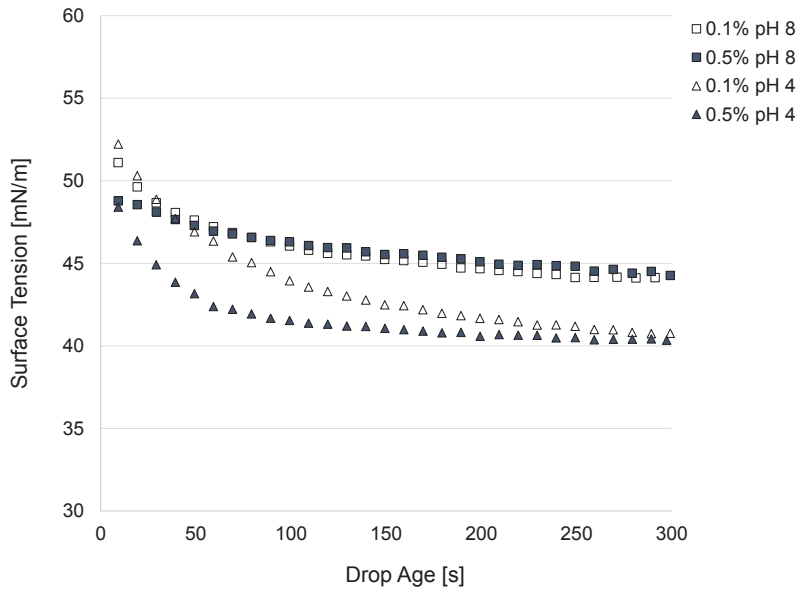


Fig. 3 Surface tension as a function of drop lifetime of 0.1% (open symbols) and 0.5% (closed symbols) aqueous solutions of PEG-120 Methyl Glucose Dioleate using the Pendant Drop Method (DataPhysics OCA 25) at pH 4 (△,▲) and pH 8 (□,■)

Where science & creativity meet

PERFORMANCE, NATURALLY BETTER!

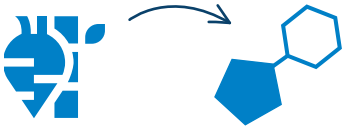
Introducing IFF's Designed Enzymatic Biomaterials (DEB) Technology

Robust and consistent performance of home and personal care products is critically important; particularly given their relevancy and presence in our daily lives. Alongside this need is the increased desire for sustainable materials and the rise in the number of natural and/or bio-based ingredients in the marketplace. Yet, without achieving performance equal to or greater than petroleum-based materials, natural and bio-based alternatives will not fully replace incumbent materials nor satisfy customer and consumers' needs.

IFF has developed a new-to-the-world class of polysaccharides that can address these considerations. The resulting innovation – Designed Enzymatic Biomaterials (DEB) – gives rise to products that drive performance enhancements while being bio-based, and can be designed to be biodegradable.

1 A sustainable, fungible feedstock

In the bio-revolution, plant-based sugars can replace fossil feedstocks. Sustainable feedstocks from agricultural crops such as sugar beet or sustainably-farmed sugar cane are converted in biorefineries into products serving the food, feed, material and energy markets.



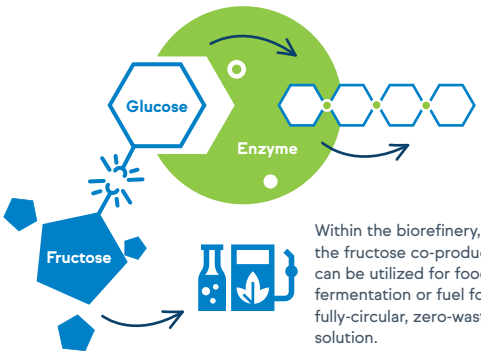
Sugar beet/cane

Sucrose
Fructose + glucose

2 Enzymatic Polymerization

The designed enzymes are used to catalyze the conversion of sucrose to form the poly-glucose material (polysaccharide).

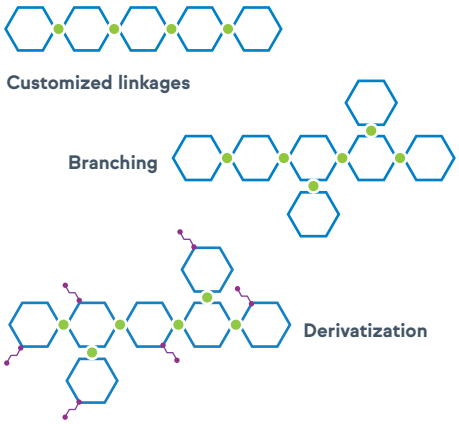
Enzymatic polymerization works at ambient temperature & pressure conditions to convert aqueous solutions of plant-sugar into the polysaccharide, which is then separated using conventional processes.



Within the biorefinery, the fructose co-product can be utilized for food, fermentation or fuel for a fully-circular, zero-waste solution.

3 Polysaccharides with highly tunable properties

The enzymatic polymerization process allows for precise control of the way glucose molecules are linked, leading to a consistent, high-quality biomaterial with customizable properties. This enables access to a wide range of polymer length, material morphologies and control in further functionalization.



The Designed Enzymatic Biomaterials bring three important benefits that makes the alpha-glucan molecule unique. They are highly customizable, have excellent structural uniformity, and can be designed to be biodegradable.

With the DEB generation of functional ingredients, formulators, brands and customers will no longer have to choose between sustainability and performance.

IFF's DEB technology takes the rational design of modern polymer science into the enzymatic polymerization/ catalysis domain and will propel this field forward and allow breakthrough scientific discoveries and industrial implementation. In fact, Designed Enzymatic Biomaterials have the potential to break the trade-off between performance and sustainability to become a true enabler for the home and personal care industry of the future.

as the material is completely water-soluble and there are no artifacts caused by crystallizable alkyl chains: The surface tension at pH 8 (□,■) is higher than at pH 4 (△,▲), and about the same plateau values are reached sooner or later, depending on the concentration; obviously, both concentrations are above the CMC. For PEG-120 Methyl Glucose Dioleate, the surface tension is just below 45 mN/m, also at pH 8; in this case, the residual oleic acid did not influence the classification as surface-active substance.

Normalization activities

The need to update the standards for the determination of surface tension and the corresponding OECD TG 115 has already been addressed in the ECETOC TR No. 133-3 (Appendix CS6-A.1) [15]; probably not coincidentally, it was also one result of the recent UBA/Fraunhofer/Ramboll project to evaluate which OECD guidelines need to be updated [25]. Since updating OECD Guidelines is a time-consuming endeavor [26], it is easier – as a first step – to develop a standard for the use of the Pendant Drop method for surfactant solutions. The CESIO WG "Test Methods of Surfactants" (TMS) decided to take action on this topic, as most of the members of the CESIO TMS are also members of the relevant standardization groups dealing with surfactant-related test methods (DIN NA 062-05-63 AA „Anwendungstechnische Prüfverfahren für Tenside"; CEN TC 276 WG 2 "Methods of Test"). Fortunately, there was already a good starting point for writing a standard on the Pendant Drop method for surfactant solutions: EN ISO 19403-3 (2020) [27] from the field of paints and coatings formulations, which needs to be modified and supplemented to be suitable for surfactants.

Summary

There are good reasons why the Pendant Drop method has been the state of the art for determination of surface tension in academic and industrial laboratories for decades. The classical ("vintage") methods (du Noüy ring/Wilhelmy plate) have serious shortcomings due to undefined surface age, especially for surfactants consisting of distributions of homologues or surface-active polymers containing hydrophobic impurities. So why are these old methods still being used today, for example in quality control? One reason is the ease of use and the availability of automated equipment. Also, the du Noüy ring and Wilhelmy plate methods are the only ones that are "official" (according to OECD Guideline 115, DIN/EN/ISO standards) in the field of surfactants. However, this is going to change: Normalization activities have already started to develop DIN/EN standards for the Pendant Drop method in the field of surfactants, which is the recommended method in those cases where not only repeatability but also the determination of the correct surface tension value is desired.

Remark

This paper is a joint effort of members of the CESIO Working Group "Test Methods of Surfactants" and the TEGEWA Working Group "Surface Active Substances": Roland Borner (Chemische Fabrik Schärer&Schläpfer AG), Wolfgang Brennich and Katrin Wunderlich (Zschimmer&Schwarz GmbH&Co KG), Karsten Holtin (Kolb Distribution Ltd.), Bernat Pi (Kao Corporation S.A.), Arjan Gelissen (Sasol Germany GmbH), Johannes Bookhold (Clariant Produkte (Deutschland) GmbH), Kati Schmidt (BASF SE), Louis Schwarzmayr (Nouryon Surface Chemistry AB), Michael Stapels (Kao Chemicals GmbH) and Joachim Venzmer (Evonik Operations GmbH).

References:

[1] *L. Wilhelmy*, "Ueber die Abhängigkeit der Capillaritäts-Constanten des Alkohols von Substanz und Gestalt des benetzten festen Körpers," Ann. Phys., vol. 195, no. 6, pp. 177–217, 1863, [Online]. Available: https://doi.org/10.1002/andp.18631950602

[2] *P. L. du Noüy*, "A new apparatus for measuring surface tension," J. Gen. Physiol., vol. 1, no. 5, pp. 521–524, 1919, [Online]. Available: https://doi.org/10.1085/jgp.1.5.521

[3] *W. D. Harkins and H. F. Jordan*, "A method for the determination of surface and interfacial tension from the maximum pull on a ring," J. Am. Chem. Soc., vol. 52, no. 5, pp. 1751–1772, 1930.

[4] *B. Song and J. Springer,* "Determination of interfacial tension from the profile of a pendant drop using computer-aided image processing," J. Colloid Interface Sci., vol. 184, no. 1, pp. 64–91, 1996, doi: 10.1006/jcis.1996.0597.

[5] *M. Hoorfar and A. W. Neumann*, "Recent progress in Axisymmetric Drop Shape Analysis (ADSA)," Adv. Colloid Interface Sci., vol. 121, no. 1–3, pp. 25–49, 2006, doi: 10.1016/j.cis.2006.06.001.

[6] *D. J. Miller and H. L. Möhle*, "Dynamic Surface Tension: Comparison of Results from Different Laboratories," SOFW-Journal, vol. 140, no. 10, pp. 12–21, 2014.

[7] European Commission, "COMMISSION IMPLEMENTING REGULATION (EU) 2018/1602 of 11 October 2018 amending Annex I to Council Regulation (EEC) No 2658/87 on the tariff and statistical nomenclature and on the Common Customs Tariff," Off. J. Eur. Union, pp. 1–960, 2018, [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R1602&from=EN

[8] European Commission, "Regulation (EC) No 648/2004 of the European Parliament and of the Council of 31 March 2004 on detergents.," Online at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32004R0648

[9] European Commission, "Questions and agreed answers concerning the correct implementation of Regulation (EC) No 648/2004 on detergents", [Online]. Available: http://ec.europa.eu/docsroom/documents/33168

[10] *J. Venzmer*, "Determination of CMCs - Results from CESIO / TEGEWA Working Groups," SOFW-Journal, vol. 146, no. 03/20, pp. 60–64, 2020, [Online]. Available: https://www.tegewa.de/en/wp-content/uploads/sites/2/2021/05/Publication-CMCs-SOFW-Journal-March-2020.pdf

[11] *G. Hodges et al.*, "A comparison of log K ow (n-octanol–water partition coefficient) values for non-ionic, anionic, cationic and amphoteric surfactants determined using predictions and experimental methods," Environ. Sci. Eur., vol. 31, no. 1, pp. 1–18, 2019, doi: 10.1186/s12302-018-0176-7.

[12] "OECD GUIDELINE FOR THE TESTING OF CHEMICALS 115: Surface Tension of Aqueous Solutions".

[13] "Surface active agents - Determination of surface tension by drawing up liquid films ISO 304:1985".

[14] "Surface active agents - Determination of surface tension EN 14370:2004".

[15] European Centre for Ecotoxicology and Toxicology of Chemicals, "Case Studies Putting the ECETOC Conceptual Framework for Polymer Risk Assessment (CF-4Polymers) into Practice. Technical Report No. 133-3," no. 133, 2021, [Online]. Available: https://www.ecetoc.org/wp-content/uploads/2021/09/ECETOC-TR-133-3-CF4Polymers-Case-Studies.pdf

[16] European Commission, "Identification of PRRs," 2020. https://circabc.europa.eu/ui/group/a0b483a2-4c05-4058-addf-2a4de71b9a98/library/6381dbc9-2e88-4034-a86d-f5fd20f9ac70/details

[17] *S. Abbott*, "Cloud and Krafft Points." https://www.stevenabbott.co.uk/practical-surfactants/cloud-krafft.php

[18] "OECD GUIDELINE FOR THE TESTING OF CHEMICALS 105: Water Solubility".

[19] "OECD GUIDELINE FOR THE TESTING OF CHEMICALS 120: Solution/Extraction Behaviour of Polymers in Water".

[20] *J. Venzmer*, "Water-soluble or not? An easy question difficult to answer," SOFW-Journal, vol. 149, no. 10, 2023.

[21] "ISO 4311:1979 Anionic and non-ionic surface active agents – Determination of the critical micellization concentration – Method by measuring surface tension with a plate, stirrup or ring".

[22] European Commission, "Council Regulation (EC) No 440/2008 of 30 May 2008 laying down test methods pursuant to Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)," Off. J. Eur. Union, vol. 51, pp. L-142/1-739, 2008.

[23] *W. J. Xia and H. Onyuksel*, "Mechanistic studies on surfactant-induced membrane permeability enhancement," Pharm. Res., vol. 17, no. 5, pp. 612–618, 2000, doi: 10.1023/A:1007581202873.

[24] *M. W. Kim*, "Surface activity and property of polyethyleneoxide (PEO) in water," Colloids Surfaces A Physicochem. Eng. Asp., vol. 128, p. 154, 1997.

[25] "Reviewing OECD Test Guidelines." https://rev-otg.com

[26] OECD, Guidance Document for the Development of OECD Guidelines for Testing of Chemicals, vol. 1. Paris: OECD Publishing, 2002. [Online]. Available: https://doi.org/10.1787/9789264077928-en

[27] "Paints and varnishes – Wettability – Part 3: Determination of the surface tension of liquids using the pendant drop method EN ISO 19403-3".

author

Joachim Venzmer

Evonik Operations GmbH

Goldschmidtstr. 100 | 45127 Essen | Germany

joachim.venzmer@evonik.com

A Biomimetic Anti-sagging Ingredient Acting on All Skin Layers, Down to the Dermo-hypodermal Junction

M. Pasquier

As we age, the structures of the skin tend to become disorganized. The skin becomes saggy and loses its firmness and elasticity. A new anti-aging active extracted from the brown seaweed *Himanthalia elongata* combats these disorganizations and acts globally in all skin layers:

- by strengthening the dermo-epidermal junction
- reinforcing the mechanical properties of the dermis
- and acting deep in the skin by strengthening the dermo-hypodermal junction.

Tested *in-vivo* for 28 days, it significantly improves skin firmness. It has also been tested on the decrease of nasogenian folds visibility. This innovative *Himanthalia elongata* extract is a biomimetic and eco-designed marine active ingredient intended to restore skin firmness.

Introduction

Skin sagging: a particular feature of aging

Skin aging is a complex and multifactorial process resulting from both intrinsic and extrinsic factors. It is mainly characterised by wrinkles, loss of elasticity, rough texture, sun spots and uneven skin colour [1].

Skin sagging is a particular feature of facial aging, visible on the lower part of the face and associated with a loss of skin firmness, dermal elasticity and prominent nasogenian folds [2] **(Figure 1)**.

According to a 2015 consumer survey conducted by the American Society for Dermatologic Surgery, **loss of firmness and sagging of the face are the main concerns of 67% of women** [3].

At a biological level, facial sagging is accompanied by progressive changes in overall mechanical and integrity properties of the skin. These changes are closely related to the skin's multilayered architecture, composition and cellular response to mechanical forces. The dermo-epidermal junction thins, mechanical properties in the dermis decrease and there is less interaction between fibroblasts and adipocytes at the dermo-hypodermal junction level.

Indeed, growing evidence demonstrated that macroscopic mechanical properties of human skin can not be considered independently of adjacent hypodermis. Fibroblasts at the dermo-hypodermal junction have been shown to be involved in the biomechanical resistance of tissues and to have strong links with adipocytes. These interactions can also modulate the mechanical properties of the dermis and influence the appearance of signs of skin aging [4].

Fig. 1 **Left:** Face with skin sagging, **right:** same face without skin sagging

In the following it will be demonstrated how *Himanthalia elongata* extract improves skin firmness and to help to maintain the integrity of the skin and fight against sagging.

Multi-level action on overall's skin mechanical properties

The innovative mode of action of *Himanthalia elongata* extract on all skin layers has been studied *in-vitro* by stimulating key molecules at different levels: the dermo-epidermal junction, the dermis and the dermo-hypodermal junction **(Figure 2)**.

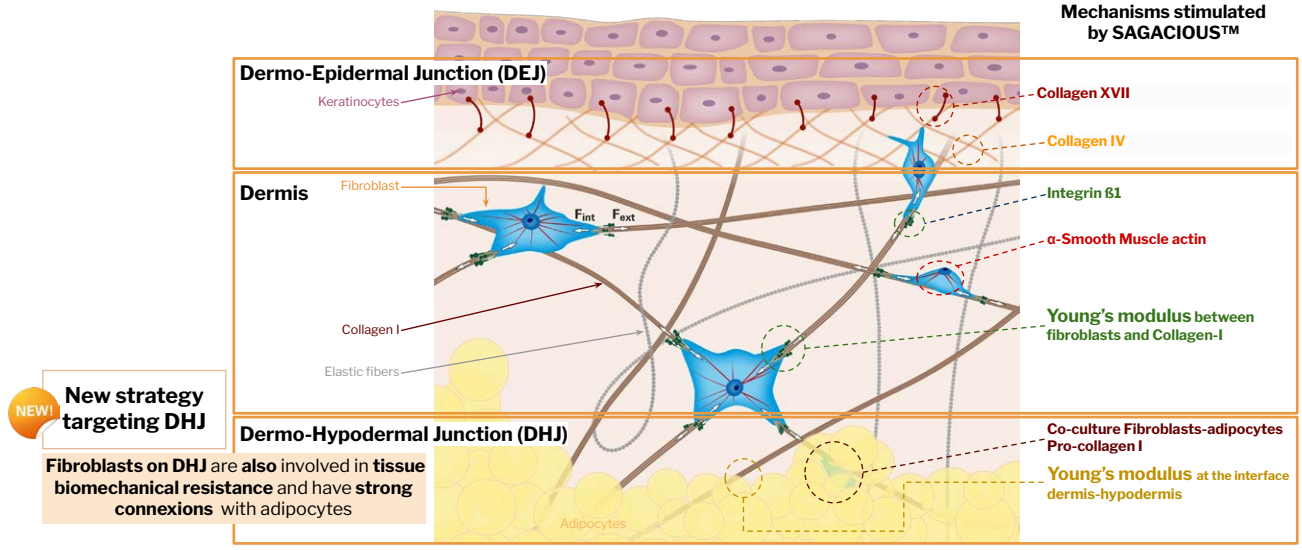


Fig. 2 Mechanisms stimulated by *Himanthalia elongata* extract

1. Action at the dermo-epidermal junction

Firstly, Himanthalia elongata extract acts at the dermo-epidermal junction and targets two key molecules **(Figure 3)**:

- The expression of **collagen IV** by fibroblasts, which is a type of collagen that is a support for the epidermis on the dermis.
- The synthesis of **collagen XVII** in aged skin, a type of collagen responsible for anchoring function for the epidermis in the dermis.

By stimulating the expression of collagen IV and XVII, two key factors located at the epidermis-dermis interface, ***Himanthalia elongata* extract reinforces the dermo-epidermal junction** and allows for a better cohesion between the epidermis and dermis. This in turn **improves the skin's structural integrity and limits skin sagging**.

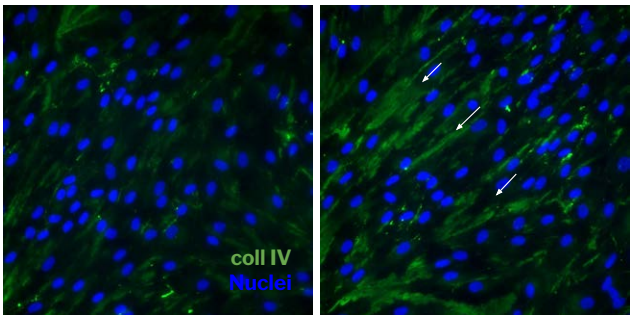


Fig. 3 Increased collagen IV expression (**left:** untreated condition, **right:** with *Himanthalia elongata* extract)

2. Action in the dermis

Himanthalia elongata extract also acts in the dermis, from the dermo–epidermal junction to the dermo-hypodermal junction and targets three mechanisms:

- The synthesis of integrin β1, which is an essential **mechanoreceptor** for fibroblasts to maximally sense mechanical tension and is known to be downregulated with age **(Figure 4)**.

- The synthesis of α-Smooth muscle actin, a **mechanosensitive protein that makes fibroblasts highly contractile**.

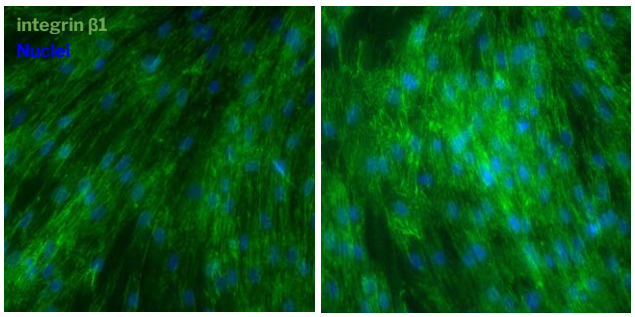


Fig. 4 Increased integrin β1 expression (**left:** untreated condition, **right:** with *Himanthalia elongata* extract)

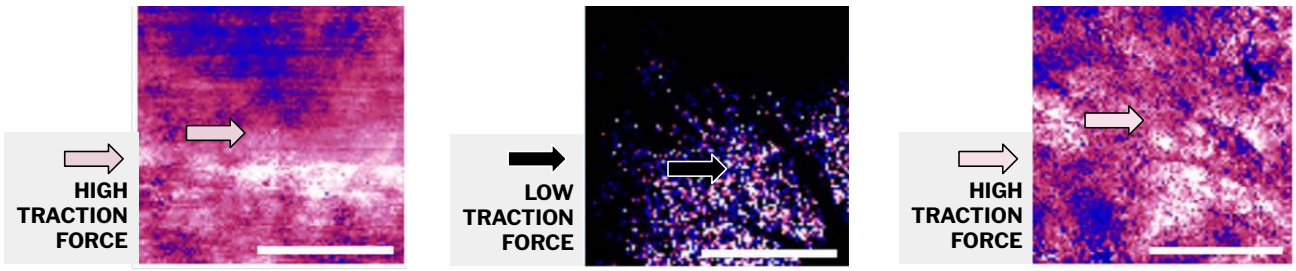


Fig. 5 Traction forces exerted by the fibroblasts on the collagen type I matrix. (**left:** young fibroblast, **middle:** old fibroblast untreated, **right:** old fibroblast treated with *Himanthalia elongata* extract

- **Tensile forces** are also stimulated. They represent the availability of fibroblasts to stretch the extracellular matrix through their cytoplasmic processes, which is directly related to the firmness of the skin. **Young's modulus** is a numerical constant that allows quantification of these tensile forces. An assessment was made between the fibroblasts and the type I collagen on untreated old fibroblasts and on old fibroblasts treated with *Himanthalia elongata* extract **(Figure 5)**.

The results showed that *Himanthalia elongata* extract was able to increase the expression of integrin β1 and α-Smooth muscle actin in fibroblasts, thereby strengthening the mechanotransduction machinery between the fibroblast and its extracellular matrix. The results also showed a significant increase in Young's modulus, indicating an increase of the mechanical tension in the dermis.

***Himanthalia elongata* extract therefore promotes mechanotransduction in the dermis, giving the skin the ability to stretch and snap back into place easily, resulting in firmer skin.**

3. Action at the dermo-hypodermal junction

Finally, the innovation of *Himanthalia elongata* extract lies in its action deep within the dermo-hypodermal junction (DHJ). Indeed, there is a strong link between fibroblasts and adipocytes and it is therefore important to target the hypodermis in anti-aging strategies [5]. It then stimulates two mechanisms:

- **Tensile forces were measured via Young's modulus** as previously described. An assessment was made at the interface between the dermis and the hypodermis

- **Synthesis of type I procollagen** by a co-culture of fibroblasts and adipocytes. This physiological model makes it possible to demonstrate the close relationship between these two types of cells.

The results showed that *Himanthalia elongata* extract significantly increased the tensile forces and thus the rigidity of the DHJ. This strong effect on the mechanical properties of the skin at the dermis/hypodermis interface helps to strengthen the overall biomechanics of the skin, thereby limiting sagging. The secretion of procollagen type I was also stimulated in the presence of this active ingredient and the co-culture, which is able to increase collagen content.

Himanthalia elongata extract was able to **reinforce the mechanical properties of the deep dermis at the interface with the hypodermis for better cohesion** by increasing the rigidity of the DHJ and collagen content.

In summary, *Himanthalia elongata* extract targets the **multi-level biological mechanisms** involved in skin sagging, specifically the deep dermis and its interface with the hypodermis, to provide a **global approach and effective anti-aging strategy** to reduce lower facial sagging and improve skin firmness.

25–27 OCTOBER 2023

SEPAWA® CONGRESS

ECC ESTREL CONGRESS CENTER BERLIN

Register now!

Facts and Figures 2022

3,175 Participants

60 Countries

302 Exhibitors

153 Lectures

www.sepawa-congress.com

#sepawacongress
#welovesepawa

Clinical evaluation on firmness improvement

Evaluation of the firmness of the skin was assessed. The dark area on **Figure 6** shows the intensity of skin deformation. The lighter it is, the firmer the skin. After 28 days of application of a cream containing 2% *Himanthalia elongata* extract , the area of deformation was significantly reduced and the skin was significantly firmer, **8 times** more than the placebo.

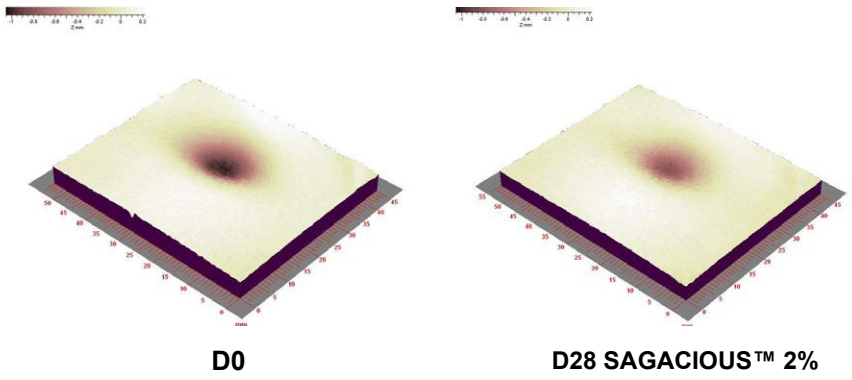


Fig. 6 Skin firmness 3D capture (**left:** before the study at D0, **right:** after 28 days of application)

Clinical evaluation on marked nasogenian folds

Measurement of the nasogenian fold area was assessed. After 28 days of use of a formula containing 2% *Himanthalia elongata* extract, **the visibility of the nasogenian fold was reduced by an average of 7.1%** compared to placebo **(Figure 7)**.

Fig. 7 Reduction of the area of the nasogenian fold (**left:** before the study at D0, **right:** after 28 days of application)

A natural active ingredient from an eco-designed process

In addition to its innovative mode of action, *Himanthalia elongata* extract is also innovative in its extraction. It is obtained from the brown algae *Himanthalia elongata*, sustainably harvested in France, from an **eco-designed** and patented process called **'Cœur d'algue'**. The extraction process has been optimised to two steps instead of four, saving time, energy and waste.

In addition, *Himanthalia elongata* extract complies with Chinese regulations and is COSMOS and Natrue approved. It is **100% natural** according to ISO 16128, contains no preservatives and is also vegan and halal compliant.

Conclusion:

Loss of firmness and sagging of the face is a big concern of women. *Himanthalia elongata* extract is a new biomimetic active ingredient, which acts globally on all skin layers. It was proven in-vitro that it is able to restore the mechanical properties of fibroblasts.

In-vivo, it was proven that it improves skin firmness, eight times more than placebo, and reduces the visibility of nasolabial folds. Skin is significantly firmer, and signs of sagging are less visible.

Himanthalia elongata extract is therefore the perfect ally of mature skin to fight against effects of time and gravity on the skin.

References:

[1] F*arage, M A et al*. "Intrinsic and extrinsic factors in skin ageing: a review." International journal of cosmetic science vol. 30,2 (2008)

[2] *Ezure, Tomonobu, and Satoshi Amano*. "Involvement of upper cheek sagging in nasolabial fold formation." Skin research and technology : official journal of International Society for Bioengineering and the Skin (ISBS) [and] International Society for Digital Imaging of Skin (ISDIS) [and] International Society for Skin Imaging (ISSI) vol. 18,3 (2012)

[3] American Society for Dermatologic Surgery (ASDS) 2015 Consumer Survey on Cosmetic Dermatologic Procedures. Data were collected from 7,315 consumers through a blind online survey in spring 2015.

[4] *Kruglikov, Ilja L, and Philipp E Scherer*. "Skin aging: are adipocytes the next target?." Aging vol. 8,7 (2016)

[5] *Ezure, Tomonobu, and Satoshi Amano*. "Influence of subcutaneous adipose tissue mass on dermal elasticity and sagging severity in lower cheek." Skin research and technology : official journal of International Society for Bioengineering and the Skin (ISBS) [and] International Society for Digital Imaging of Skin (ISDIS) [and] International Society for Skin Imaging (ISSI) vol. 16,3 (2010)

author

Marine Pasquier
Market & Digital Manager – Cosmetics
Seppic S.A.
50 bd National | La Garenne Colombes Cedex | France
info.seppic@airliquide.com

CSC
COSMETIC SCIENCE CONFERENCE
25–26 OCTOBER 2023

SHOWER FOAM CHARACTERIZATION

A Comparison of Human Evaluation and Instrumental Analysis

BY DR. SVEN MUNKE
DGK FG Hautreinigung

WED, 25 OCT 2023
09:30 am

Shower foam volume is a key attribute of skin cleansing products and associated with positive product performance. Thus, **evaluation of the amount or volume of foam is crucial for product development and benchmarking.** For this evaluation reliable methods are required. Aim of the present study was to investigate the correlation between sensory panel results (expert and lay) and instrumental analysis. **Subjective results** of a lay and various expert sensory panels in a multi-center approach were **compared to standardized instrumental measurements** and analyzed statistically.

Get your ticket now

www.sepawa-congress.de/registration

in conjunction with
25–27 OCTOBER 2023
SEPAWA CONGRESS
ECC ESTREL CONGRESS CENTER BERLIN

organized by
DGKeVent GmbH
DGK cosmetic science
SOFW

Greek Mountain Tea for Beauty Sleep and Night-Time Recovery

B. Walzel, A. Herrmann, U. Bätz, T. Shahzad, B. Senti, S. Bänziger

abstract

Good sleep is essential for our mental and physical health. Good sleep also makes our skin look more radiant and refreshed [1]. Tea rituals are known to promote sleep. They help to relax and unwind, they create a mood of calm, and they facilitate sleep. Therefore, tea-inspired ingredients are a good starting point to create cosmetic night-care concepts, especially ingredients derived from herbal teas that are free of stimulating substances.

Greek mountain tea *(Sideritis scardica)* has a long tradition as natural remedy to calm body and mind. This unprocessed, caffeine-free, herbal tea has been used for centuries as natural sleep support. But there is more to mountain tea: it contains protective and regenerative phytochemicals that help our skin to recover overnight.

Here we present Mountain Tea Pro (from now on called "Mountain Tea Extract"), a natural extract of organic *Sideritis scardica* herb from a traceable source, that brings together the concept of tea-inspired beauty rituals and activity-proven benefits for skin. It is a perfect cosmetic ingredient to create relaxing night-care, mood-enhancing self-care, and beauty-sleep products.

Mountain tea – a tradition of calming and relaxing

Mountain tea is a legendary herbal tea made from the leaves and flowers of *Sideritis scardica* **(Figure 1)**. The plant is found in the Mediterranean mountains of Greece, Albania, Bulgaria, Macedonia, or Turkey where, according to local tradition, the herb carries different names: For example, it is referred to as "Olympus Tea", when grown around Mount Olympus (the home of the Greek gods) or as Shepherd's Tea because Greek shepherds prepare their tea high in the hills from freshly picked *Sideritis* plants [2,3].

Fig. 1 The famous *Sideritis* herb in its natural habitat.

For its delicious taste and health benefits mountain tea has been used for centuries as natural remedy to relax, to treat anxiety or depression, but mostly, this caffeine-free herbal tea is used as natural sleep support until today [4]. In contrast to classical black tea, mountain tea has never been part of sophisticated afternoon teatime rituals. Instead, it has remained a humble, unprocessed, natural, and caffeine-free herbal tea that is liked by the common population in the Balkans, loyal to their traditions.

Today, herbal teas with their strong traditional values and mood-enhancing qualities, perfectly fit into a lifestyle of self-care and well-being. This is why tea rituals are a great inspiration for beauty concepts. They create emotional moments that calm, relax, and facilitate sleep. And beauty sleep is a real thing! Researchers found that sleep is essential for health, well-being, productivity, memory, and aging [1]. In sleep experiments they could show that people who miss out on sleep do appear less attractive to others [1]. Thus tea-infused beauty concepts perfectly address consumers that look to balance their hectic lifestyles with relaxing self-care. Here, mountain tea *(Sideritis scardica)* offers great opportunities.

Ethical sourcing – organic raw material from a Greek farming family

Lipoid Kosmetik sources *Sideritis scardica* as raw material for the Mountain Tea Extract (INCI: Glycerin, Aqua (Water), *Sideritis Scardica* Flower/Leaf/Stem Extract) from a local family

plantation in the mountainous backland of Western Greece – a remote, rural region void of industry pollution or urban centers **(Figure 2)**. The tea's cultivation is fully organic, and its harvest has remained traditional, where leaves are hand-picked, bundled, and dried on open air. The sourcing supports local business and promotes the well-being of the local population.

Fig. 2 Organic farming of mountain tea herb in Western Greece.

Mountain Tea Extract – caffeine-free and rich in protective compounds

This study's objective was to highlight the presence of secondary metabolites in Mountain Tea Extract with protective and regenerative activity and to show the absence of secondary metabolites with potentially energizing, stimulating, or activating function - notably caffeine, which is known to trigger the skin's energy metabolism.

The presence of protective flavonoids and phenolic compounds was validated by high-performance thin-layer chromatography (HPTLC) analysis **(Figure 3A)**. The relative content of caffeine was quantified by high-performance liquid chromatography (HPLC) analysis **(Figure 3B)**.

As a result, Mountain Tea Extract has a high-value flavonoid and phenolic compound profile **(Figure 3A)** with protective and regenerative phytochemicals that support skin recovery. Yet, in contrast to classical tea varieties (derived from *Camellia sinsensis*), mountain tea does not contain stimulating caffeine **(Figure 3B)**. This makes Mountain Tea Extract an optimal cosmetic ingredient for calming, relaxing, and de-stressing night-care.

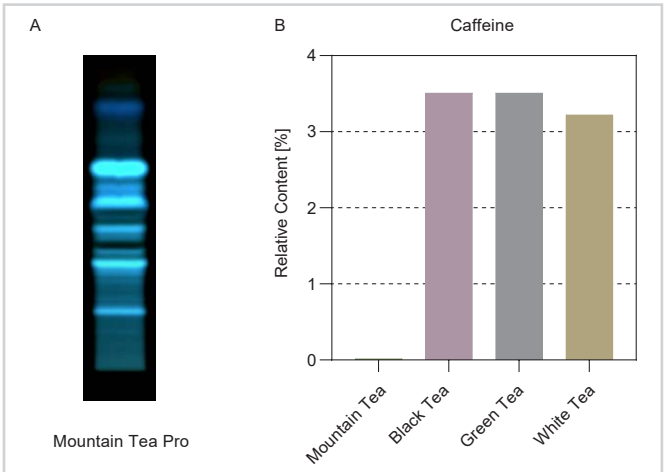


Fig. 3 Mountain Tea Extract is rich in protective and regenerative compounds but void of stimulating caffeine. **A:** HPTLC analysis shows the abundance of phenolic acids and flavonoids in Mountain Tea Extract (various fluorescent bands). **B:** HPLC analysis shows high caffeine levels in the leaves of classical black, green, and white tea but none in mountain tea herb.

Mountain Tea Extract protects from light-induced oxidative stress

This study's objective was to show that Mountain Tea Extract has antioxidant activity and to show that mountain tea activates the skin's cellular antioxidative defense system.

In an *in vitro* study, cultured human keratinocytes were preincubated with Mountain Tea Extract in the presence of a photoinducible biosensor and exposed to light flashes. The amount of generated free radicals was quantified using a LUCS (Light-Up Cell System) [5].

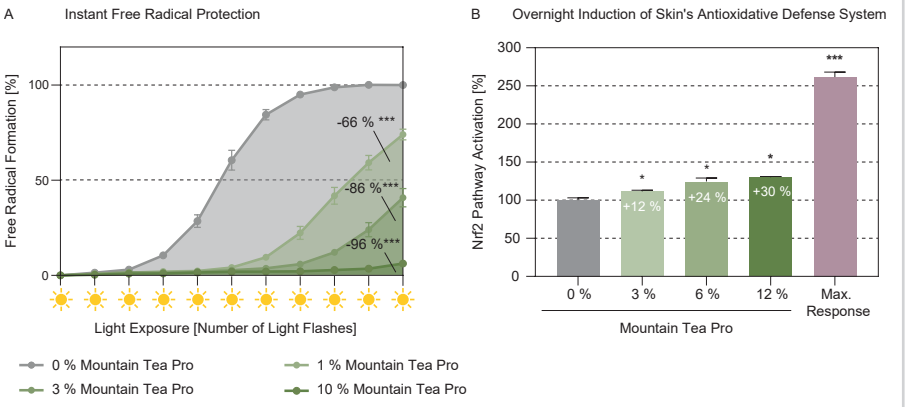


Fig. 4 Mountain Tea Extract strengthens the skin's intrinsic antioxidative defense – directly and indirectly. **A:** Kinetic data of real-time free radical production upon light stress. **B:** Increase of Nrf2 downstream gene activation. Both tests were performed as two independent experiments, each with triplicates; Mean +/- SEM; Student's t-test versus untreated; * = $p < 0.05$; *** = $p < 0.001$.

In a second *in vitro* assay, the cells were preincubated with Mountain Tea Extract and the skin's capacity to adapt to oxidative stress was measured using the Nrf2 reporter gene assay. This assay quantifies the activation of the Antioxidant Response Element, a binding site of the nuclear transcription factor Nrf2, which is a master regulator for antioxidant enzymes and proteins in the skin. Activation of the Nrf2 pathway increases the skin's capacity to adapt to oxidative stress [6].

As a result, Mountain Tea Extract showed strong antioxidant protection already at low concentrations. The incubation with 1% Mountain Tea Pro was sufficient to reduce the number of intracellular, free radicals by 66% **(Figure 4A)**.

Further, Mountain Tea Extract boosts the skin's capacity to adapt to oxidative stress by activating the Nrf2 pathway **(Figure 4B)**. Overnight incubation with Mountain Tea Extract stimulated the synthesis of antioxidative defense genes by 12 – 30% in a concentration-dependent way. As positive control, 25 µM of sulforaphane were used to reveal the maximal response of the system.

Overall, Mountain Tea Extract provides direct and instant antioxidant protection as it neutralizes light-induced free radicals. Further, it indirectly protects from oxidative stress by activating the skin's own defense system. Hence, Mountain Tea Extract is an effective ingredient for protective and regenerative skin-care.

Mountain Tea Extract restores the skin's antioxidative potential

This study's objective was to show that Mountain Tea Extract regenerates the skin´s antioxidative potential (SAP), which was weakened earlier by exposure to sunlight. The skin´s SAP is the capacity to neutralize free radicals [7].

In this *ex-vivo* test, the SAP was measured before and after exposure to artificial sunlight emitted by a solar simulator. Light exposure induced free radicals inside the skin that were quantified by electron spin resonance (ESR) spectroscopy.

As a result, repeated sunlight exposure reduced the skin´s capacity to cope with oxidative stress by 48%. At night, in the absence of sunlight, this depletion of SAP naturally recovers by 9% without any treatment, whereas the application of Mountain Tea Extract boosts the regenerative process, lifting the SAP to 37% **(Figure 5)**.

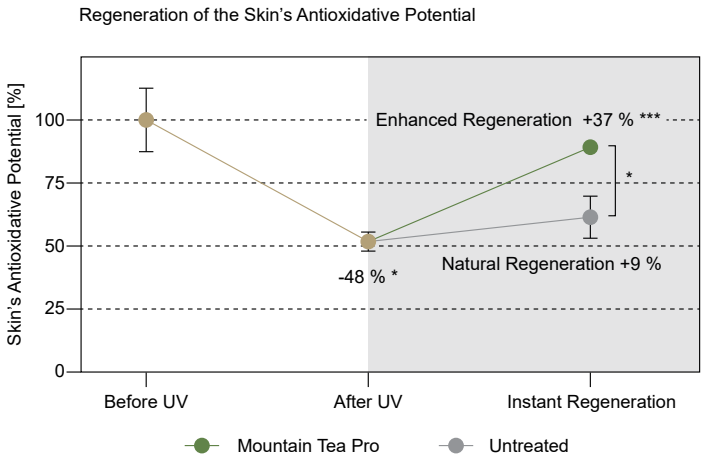


Fig. 5 Sunlight exposure depleted the skin's antioxidative potential (white area left). The subsequent application of Mountain Tea Extract in the absence of light exposure (gray area right) rapidly reverts the skin's antioxidative potential (SAP). SAP was measured by electron spin resonance (ESR) spectroscopy in an *ex vivo* skin model. N = 3-4; Mean +/- SEM; Student's t-test versus baseline and between treatments; * = $p < 0.05$; *** = $p < 0.001$.

SOFW eVENTS

WeCONNECTING industries

Picture Credits: Roman Samborskyi / Shutterstock.com

Do you already know our SOFW eVENTS?

At SOFW, we've been thinking about how we can better inform you with knowledge and the latest developments from our industry. The answer: our SOFW eVENT series.

What is it?

These are digital, topic-oriented lecture series and interviews that give you a current insight and update on products, processes and scientific developments. The duration of the event is 4-6 hours. The presentations themselves are about 30 min.

Which topics are addressed?

We focus on home care, skin care, sun care, hair care and sustainable packaging in relation to cosmetics and household products.

When are the next events?

December 07, 2023
Skin & Sun Care
Skinnovation 23

What does the whole thing cost you?

Nothing. There are no costs for visitors of our online eVENTS. However, you must register for the event.

More info?

www.sofwevents.com

Are you interested in a presentation or sponsorship? Please contact us at eVENTS@sofw.com

Mountain Tea Extract – The Night-Time Remedy for Skin Recovery

In conclusion, Mountain Tea Extract brings together the concept of tea-inspired beauty rituals and activity-proven benefits for skin. Mountain Tea Extract conveys a mood of calm and relaxation, it is free of stimulating caffeine, and it recovers the skin's daylight-depleted stress-resistance at night. In addition, the plant material is of organic quality from a traceable source, grown in a way that is sustainable and socially responsible.

This makes Mountain Tea Extract an excellent active ingredient for cosmetic night-care, for tea ritual-inspired beauty concepts, for de-stressing and calming wellness applications, for relaxing evening care, for mood-enhancing self-care, and for beauty-sleep products **(Figure 6)**.

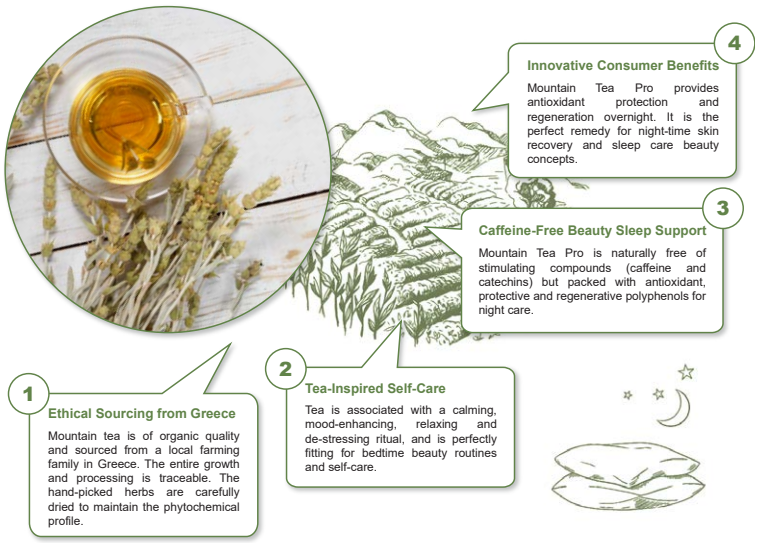


Fig. 6 Mountain Tea Extract – The Night-Time Remedy for Skin Recovery. Mountain Tea Extract is a glycerinic-aqueous extract from organic mountain tea herb (*Sideritis scardica*, *Lamiaceae*), preservative free/ self-preserving. COSMOS-certified, activity-proven extract. The extract is Swiss-manufactured and is best used at 1-5 % use level.

References:

[1] *T. Sundelin et al.*, Negative effects of restricted sleep on facial appearance and social appeal. R Soc Open Sci. 4 (160918). 1-9 (2017).

[2] *I. Chinou, B. Kroes*, Assessment report on Sideritis scardica; Sideritis clandestina; Sideritis raeseri; Sideritis syriaca, herba. (European Medicines Agency (EMA); Committee on Herbal Medicinal Products (HMPC)). 39455 (2016).

[3] *I. Aneva et al.*, Genus Sideritis, section Empedoclia in southeastern Europe and Turkey - studies in ethnopharmacology and recent progress of biological activities. Daru. 27(1), 407-421(2019).

[4] *D. Żyżelewicz et al.*, Polyphenols and other bioactive compounds of Sideritis plants and their potential biological activity. Molecules. 25 (3763), 1-18 (2020).

[5] *C. Gironde et al.*, AOP1, a new live cell assay for the direct and quantitative measure of intracellular antioxidant effects. Antioxidants. 9 (471), 1-16 (2020).

[6] *Q. Ma*, Role of nrf2 in oxidative stress and toxicity. Annu Rev Pharmacol Toxicol. 53, 401-426 (2013).

[7] *K. Jung et al.*, The antioxidative power AP--A new quantitative time dependent (2D) parameter for the determination of the antioxidant capacity and reactivity of different plants. Spectrochim Acta A Mol Biomol Spectrosc. 63 (4), 846-850 (2006).

authors

Dr. Bernd Walzel,
Dr. Anja Herrmann,
Dr. Ulrike Bätz,
Tamina Shahzad,
Beatrix Senti,
Dr. Stefan Bänziger,

Lipoid Kosmetik
Sennweidstrasse 44/46 | CH-6312 Steinhausen | Switzerland
www.lipoid-kosmetik.com

BergaMuls ET 2 – The Sustainable Choice for Modern Cosmetic Formulations from Upcycled Emulsifi(b)ers

Kristin Köhler

Developing sustainable and natural cosmetic formulations starts with the selection of suitable raw materials. Upcycled dietary fibers from agro-food industries e.g., cellulose or gums can meet requirements, as explained subsequent. The fibers can be soluble or insoluble in water leading to different functionalities within the formulation i.e., supporting emulsion stability and viscosity. Besides rheological properties, the fibers contribute to an outstanding skin feel after application and can sooth the skin additionally.

By combining cellulose, gum, and ß-glucan, we developed an all-natural o/w emulsifier and stabilizer to offer a sustainable solution to the formulator. While the insoluble ß-glucan fibers derived from oat adjust at the oil-water interface to help building a pickering emulsion, the cellulose and guar gum create a gel network to further stabilize the well-distributed particles leading to a dual mode of action and robust emulsion products. BergaMuls ET 2 is the latest product of our growing range of green emulsifi(b)ers, which comes as a water-less powder based on the dried and milled fibers mentioned. The sustainable sourcing from abundant and draught-resistant materials is just another advantage of working with BergaMuls products.

The cornerstone of this range was laid more than a decade ago with the launch of BergaMuls ET 1 and we were far ahead of the trend curve. In contrast to the new version of **BergaMuls ET 2**, which acts as emulsifier and co-stabilizer for o/w emulsions, BergaMuls ET 1 works best as thickener for oil-free systems and serum formulations or to enhance the sensorial aspects of more caring products. Both products are extremely mild to the skin barrier as they do not exhibit surface activity which make them suitable for emulsifier-free concepts. In contrast to traditional emulsifiers used in natural cosmetics, which are known to the market in terms of processing and sensory, BergaMuls ET 2 is not esterified, but cold-processable and therefore also less likely to create soaping effects. The viscosity of an o/w emulsion using this new fiber from Berg+Schmidt as emulsifier increases linearly with the size of the oil phase. Consequently, the ingredient allows to formulate products ranging from light, translucent and refreshing cream-gels to caring lotions and compact creams. The typical use concentration is between 1-3%, making it an economic must-have for modern formulations.

With consumers becoming more and more aware of what is in fact contained in their cosmetic products and which ingredients are favorable from an ecological viewpoint, BergaMuls products can help to increase consumer acceptance, too. Consumers want to take eco-responsibility for their consumption patterns. Let's help them to make good and sustainable choices. The new BergaMuls ET 2 upcycled from food by-products, allows for zero waste policy, circularity, and sustainable approaches, comes as a water-free and vegan raw material and is the ideal ingredients for tomorrow's cosmetic formulations of conscious consumers.

Berg+Schmidt
Functional Lipids

Berg + Schmidt GmbH & Co. KG | An der Alster 81, 20099 Hamburg, Germany | +49 / 40 / 284 09 58 - 0
cosmetics@berg-schmidt.com | www.berg-schmidt.de

Rapid Microbial Quality Control Methods Increase Supply Chain Speed

M. Youngkin

Cosmetic, home, and personal care product manufacturers are constantly under pressure to get their products on shelves faster. Products must be shown to be safe, effective, and have consistent quality with each use prior to arriving on shelf. The manufacturer must be doing its due diligence to guarantee all those expectations are met via quality control testing. You are only as fast as your slowest method. If you're using traditional microbial testing, then you're missing out on what is probably the single greatest opportunity to take days out of your manufacturing process. A rapid microbial detection technology benefits both the lab and operations in streamlining processes while making sure your products are going to distribution on time and safe for use. Take steps to evolve your microbial testing process using rapid methods to bring the efficiency that you expect from your manufacturing line into the lab. The effort that you put into switching from a traditional to a rapid method is miniscule compared to the efficiency that you'll gain with a rapid microbial method.

Cosmetic, home, and personal care product manufacturers are constantly under pressure to get their products on the shelves faster. Quality Control testing demonstrates the products are safe, effective, and have consistent quality with each use. The manufacturer must be doing its due diligence to guarantee all those expectations are met.

Companies push themselves to streamline and accelerate process flows while managing expenses. Even going as far as hiring consultants to bring organization and automation into their flow of goods, saving snippets of time and money wherever possible. But there is one often overlooked opportunity to speed up a product's time to market, evaluating how your company tests for microorganisms, screening for product quality and safety. Traditional testing for microorganisms is through a very manual plate counting method. It is reliant on microorganisms, if present and alive, being able to grow enough to become visible to the human eye. This process takes days.

There are new technologies that can replace the traditional method that significantly reduce time to results without reducing quality. Rapid microbial detection methods are not just a benefit for your microbiological lab, they can have a direct effect on your operational efficiencies. With new technology, product release approvals can be made with confidence, timelines can be shortened, and you can release your products days faster than before.

The days waiting for results with the plate method are also days of inventory investment sitting idle. When you use a rapid method, the quality control laboratory is no longer the bottleneck as you are waiting to release your products to the market. Rapid methods can help you meet your production and shipping deadlines and know for certain that your products are safe for consumers.

Days That You Get Back Help the Lab

A rapid microbial testing system can provide fast, objective results with instruments that automatically produce results, drastically reducing subjectivity and the risk of human error. Rapid methods often make microbial testing laboratories more efficient, and can require less time, materials, and expertise to operate. A more efficient lab allows you to put your trained microbiologists on projects that require their specific skills instead of wasting their time looking at plates all day. Make the most of your quality control lab. They can spend the time where you need them like environmental monitoring and risk assessment.

If you're using traditional microbial testing, then you're missing out on what is probably the single greatest opportunity to take days out of your manufacturing process. You spend days waiting for microbial results while inventory is on "QA hold". A rapid microbial method gives you the same results in a fraction of the time. Moving to a rapid method can have significant impact in both your lab and operations. Rapid methods give you automated results, increased data integrity, and in case of a contamination event, faster corrective action.

A typical day in the life of a quality control microbiologist is full of reviewing plate after plate and "counting" microbial colonies. Often microbial presence can be an uncommon event and your microbiologists are essentially counting zero

colonies. In a typical, controlled manufacturing facility, over 97% of products pass the final microbial limits test. This is where the economic benefit of a rapid microbial method is at its highest. A simple, rapid test that provides a presence or absence result could be all that you need to release your products. For the small percentage of products that test positive for microorganisms, they can be triaged through the rapid method initial screen and then selected to undergo further evaluation. By taking this route, exceptions are isolated and managed, allowing you to release the in-specification products days faster than before. When you use a traditional method, nothing is fast tracked, and everything whether it's a positive or a negative result, takes time. A rapid, presence/absence primary screen will indicate which products can be immediately moved to distribution and others that need a deeper look.

Rapid microbial detection methods provide opportunity to add efficiencies to your lab. Using rapid methods, products can be incubated, tested, and released in as few as 24 hours, trimming four days from the average production cycle. Additionally, many of today's rapid screening systems can provide accurate results on a broad range of products across the entire industry. These alternative methods are validated and accepted by regulators around the world.

While rapid microbial methods offer significant value to quality control labs, choosing the wrong system can cause frustration, delays, and waste. Therefore, it's critical to understand what your lab and operations needs from a rapid method such as product compatibility, sample throughout of the machine, and time to results, just name a few. Some rapid methods can process a large number of samples with minimal effort. Reducing labor, physical lab space and other resources needed for testing, allows your lab to run at maximum efficiency. Faster results enable companies to detect contamination earlier by testing upstream in their process like raw materials and in-process samples.

However, not all rapid methods are created equal. Some may require extra preparation steps, have system complexity, or need multiple systems. Understanding the real value of a rapid method starts with knowing your options and the different types of technologies out there to find the best fit for your company. Choosing the right rapid microbial detection method can make a significant impact to your lab and operations, by getting the results you need quickly and ensuring product quality. Adapting your process to use a rapid method isn't just about improving the efficiencies in the lab but can have a significant impact on production flow as well.

Managing Production Efficiently

A rapid microbial testing system represents a new best practice for manufacturers with many positive downstream effects. Getting your results days faster, allows you to not only release faster but in the event of contamination, identifying it earlier, which impacts the company both operationally and financially. This is an opportunity to improve your company's profitability by effectively streamlining the manufacturing process including your quality control lab. Rapid methods benefit your entire organization, starting from the bottom up.

Think of it as a domino effect – with a rapid method, your quality control lab is able to deliver quick and accurate answers on whether your products are contaminated or not, enabling your company to make a more confident decision on safety before shipment deadlines. Products are no longer stuck in quarantine, waiting for a go/no go result. Using the traditional method often leads to delays and can grind your manufacturing/product release to a halt by holding up and delaying shipping.

When you release products faster, held inventory and working capital requirements are reduced – saving you time and money… which are really appreciated by stakeholders and financial teams. Frequent inventory turnover and shorter production cycles are required to maximize profitability and help reduce out-of-stock inventory. This allows improvement and optimization of warehouses.

To financially justify the transition to a rapid method, companies need to quantify the overall value using company-specific information as a good starting point to estimate potential savings. These should include the cost of capital, average value of daily finished goods, current days products are held for microbial testing, and the volume of supplies used weekly. Using a rapid microbial detection method can help make faster business decisions regarding your company's large portfolio of raw materials and finished products and offer significant long-term value for your company.

The Positive Financial Impact

Quality labs need to communicate and justify adoption of new technologies. Fortunately, it is possible to quantify the financial value of time for rapid screening systems. For example, a high-throughput rapid microbial testing system for a mid-size personal care product manufacturing site can be purchased and installed for less than $50,000 in capital expenditure, achieve payback in six to nine months, and realize an average five-year net present value (NPV) in excess of $500,000. These numbers are based on averages generated using a Financial Impact Assessment developed by a global consumer products company in conjunction with a global management consultancy. The Impact Assessment, which was designed to quantify the value of implementing rapid screening, estimates the payback period and five-year NPV using a company's specific manufacturing and testing data – such as cost of capital and average daily output of finished goods. Proven accurate over years of use, the analysis is routinely used to support capital equipment purchase requests. Implementing rapid screening goes a long way toward improving overall facility efficiencies with a host of quantifiable benefits.

How to Choose the Right Technology

Upgrading to a rapid method is an investment in efficiency and quality. With all the different types of rapid microbial detection methods, you need to be sure that you choose the right one. The "best" rapid method for your company should be able to test a wide range of product matrices commonly seen in the personal care industry. Cosmetics, home and personal care products have a wide variety of aesthetics, ranging from solids to liquids, and some which cannot be filtered. Some rapid methods will require extra preparation steps as part of their testing requirements and others do not, which could require additional investment in multiple rapid method testing systems. Don't compromise the flexibility you have when switching from a traditional method to a rapid method. Replacing a traditional method with a single, harmonized rapid method platform will allow you to test a wide range of products and realize the greatest ROI and speed to market for your company.

You spend a lot of time and effort optimizing your supply chains and one of the best ways to further optimize microbial testing is implementing a rapid method that is automated and will help mitigate the risk of human error. Most rapid methods have some degree of automation but always consider the potential maintenance required. Are the systems easy to use? Do the systems require specialized technicians to run and maintain the machine? What is the necessary maintenance to keep the systems running?

Finally, laboratory space is not an area you should overlook. Some rapid detection instruments require a large amount of lab space for the machine and even more space for sample preparation. So, consider what space you have available for your rapid method equipment. Look for a system with a small footprint that can easily integrate into the existing lab bench space and readily handle throughput requirements streamlining the laboratory process flow.

You are only as fast as your slowest method. The effort that you put into switching from a traditional to a rapid method is miniscule compared to the efficiency that you'll gain with a rapid microbial method. A rapid method is technology that benefits both the lab and operations in streamlining processes while making sure your products are going to distribution on time and safe for use. Take steps to evolve your microbial

testing process using rapid methods to bring the efficiency that you expect from your manufacturing line into the lab.

How Can Charles River Laboratories Help You?

To successfully implement a rapid method, you need to have an active relationship with a supplier who has the appropriate regulatory and validation experience, as well as global technical support, and also understands your needs.

We've purposely built our portfolio to bring you progressive products and services that deliver accurate, relevant, and reliable data to fuel confident decisions on product quality and contamination control. Our unique combination of Celsis® rapid microbial detection and Accugenix® microbial identification keeps your quality control lab and manufacturing operations running efficiently and smoothly. By using our technologies, your facility can benefit from fast microbial detection with a harmonized identification program to help you get safe products in the hands of consumers quickly.

Explore our portfolio of integrated services at www.criver.com/industry/personal-care-and-cosmetics.

For more information about our microbial solutions for ensuring the safety and quality of cosmetic, over-the-counter (OTC), personal care, and household products go to: www.criver.com/consult-pi-ms-personal-care-cosmetics-testing.

author

Minu Youngkin

CHARLES RIVER LABATORIES MICROBIAL SOLUTIONS
1023 Wappoo Rd STE 43B | Charleston | SC 29407 | USA
1.877.CRIVER.1 (+1.877.274.8371)
Email: askcharlesriver@criver.com
https://www.criver.com/industry/personal-care-and-cosmetics

How to Increase Efficiencies in Cosmetic Emulsion Production While Simultaneously Reducing Emissions?

J. Fiedler

Efficient production in the cosmetic industry has far-reaching effects on CO_2 emissions, cost structures, production times, and ultimately the industry's profitability. This article provides approaches and recommendations for optimizing the production of emulsions in cosmetic manufacturing. The selection of raw materials, phase construction, production processes, and machinery are considered to reduce emissions and enhance efficiency. Although the focus is on emulsions, other aspects of production optimization are also relevant. Close collaboration between development and production, along with targeted measures, can lead to significant improvements.

Efficient production in the cosmetic industry has far-reaching effects on CO_2 emissions, cost structures, production times, and ultimately the industry's profitability. Energy and water emissions are integral to the sustainability balance in this sector. The following article provides approaches for optimization and related recommendations to company management, developers, as well as technical and production staff. The article's emphasis lies in the production of emulsions in cosmetic manufacturing, although other aspects such as single-phase production, filling, cleaning, and planning processes with regard to production optimization are relevant.

The development of emulsions often relies on marketing profiles that define the characteristics of the final product. Consideration of production optimization is frequently overlooked. There is often a strong focus on efficacy claims, sensory aspects, or bulk costs, which are primarily defined by raw material costs. However, the selection of raw materials, phase construction, production processes, and machinery offer diverse opportunities to optimize production and emissions, leading to more sustainable products.

Developers already have numerous opportunities today to optimize production efficiency during the creation and formulation of emulsions. A structured approach can lead to rapid improvements and significant savings. However, tight deadlines and limited capacities in development departments often hinder more intensive work. Particularly, small and medium-sized enterprises (SMEs) regularly lack specialized personnel and therefore rely on the experiences and knowledge of the development department. Changes to production instructions or optimizations usually require involvement of the development department, which is simultaneously working on innovations and formulation changes. Hence, priorities are mostly confined to innovations, with less focus on production optimizations.

When implementing cold/cold processes, production efficiency and capacity can be increased by up to four times the output. Instead of a single bulk production with a complex formulation and multiple ingredients in single-shift operation, up to four approaches per day are feasible. With the use of campaigns or one-pot concepts, this potential can be further enhanced.

What are the procedure options?

Conversely, the hot/hot process is the least efficient in terms of emissions and production capacity. Nevertheless, it is the most commonly used method. Nonetheless, with a specific focus on raw materials, processes, and machine characteristics, optimizations can also be made here.

Mixing processes such as hot/cold, hot/warm, or even hot/hot/cold provide opportunities for optimization while also offering solutions for sensory aspects or raw material profiles. Optimizations often depend on the machines used **(Figure 1)**.

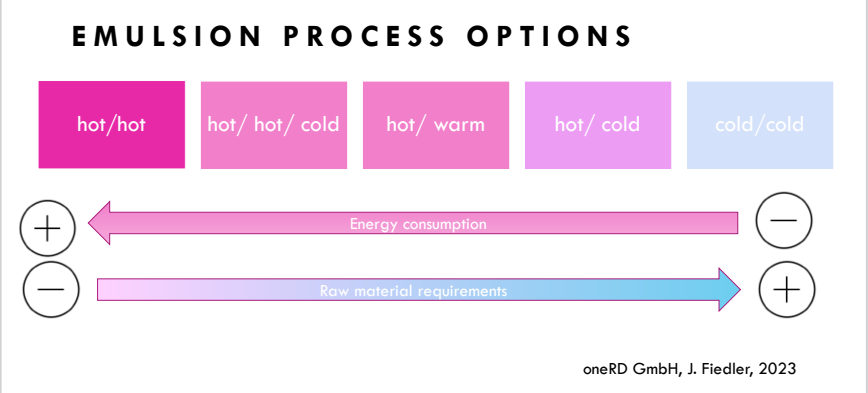


Fig. 1 Emulsion Process Options

To increase production efficiency, diverse knowledge is required at various points within the company. The effort for these optimizations is particularly high in the initial phase. Therefore, companies should approach this challenge systematically and formulate corresponding goals. How can production efficiency be actively increased?

How can production efficiency be actively increased?

Raw material selection plays a crucial role in formulation profiles and sensory attributes. It also significantly impacts production and its efficiency. Special attention should be given to the construction of the water and oil phases.

Today, the use of natural and more sustainable materials is preferred. The use of biopolymers and modified biopolymers is increasing, which brings specific requirements for water availability, temperature ranges, and swelling times **(Figure 2)**.In comparison to traditional formulations with acrylic thickeners like carbomers, this often requires longer and more complex processes.

The oil phases are also changing due to sustainability requirements. The use of hydrolyzable lipids is increasing, while silicon organic compounds and hydrocarbons are decreasing.

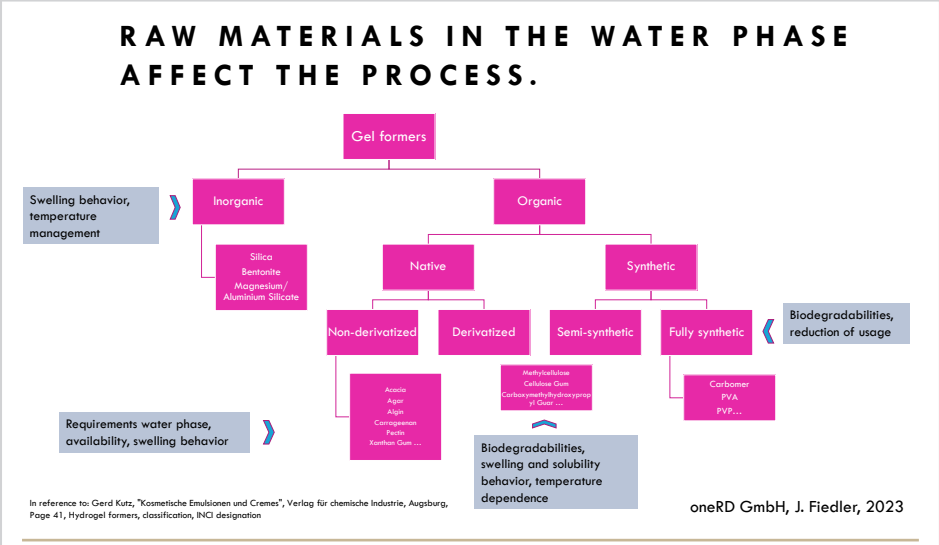


Fig. 2 Water Phase Raw Materials

This affects formula construction and offers potential for optimizations **(Figure 3)**. Measuring the melting point of the oil phase using DSC (Differential Scanning Calorimetry) is advisable. After knowing the melting point, the overall melting temperature can be influenced. In combination with suitable oils, oil phase melting temperatures can be positively affected.

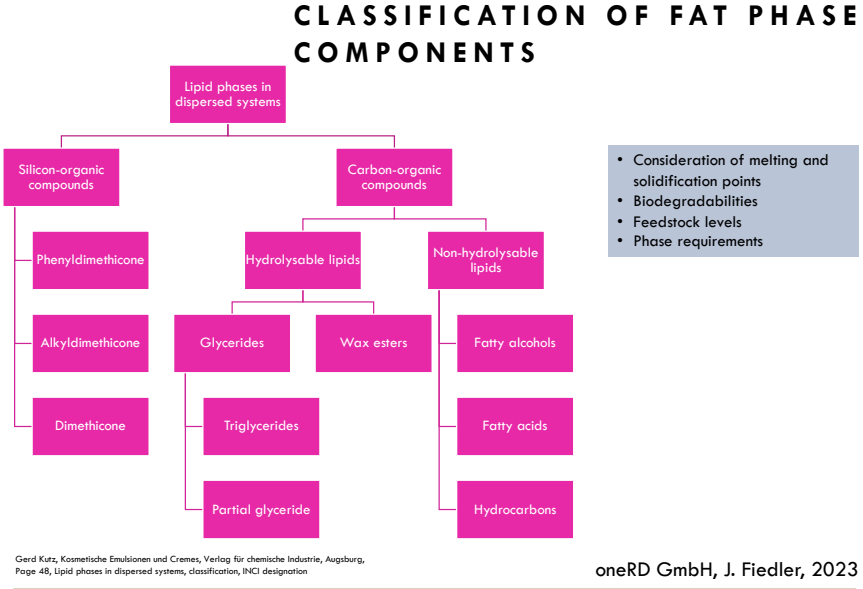


Fig. 3 Classification of Oil Phase Components)

The selection of the emulsifier holds special significance as it can have an impact not only on the melting temperature of the oil phase but also the sensory profile and texture of the formulation. The use of liquid or low-melting fat components is desirable as they require less preparation and energy and enable cold processes, which are to be aimed for as the ideal method.

Composition and phase construction are additional important factors for increasing production efficiency. Knowledge of the raw materials and machines influences decisions in development and thus the final recipe. Water plays a particular role as the main element in most emulsions. It stores energy very well, which is why high amounts of energy are needed to heat or cool it. Therefore, water should only be heated as much as necessary and in minimized volumes. In contrast, the oil phase heats up much faster. Increasing the oil phase can reduce the water phase and thus increase production efficiency. The division of phases should be individually considered. In some cases, a portion of the water phase can serve as a cooling phase, allowing for the application of a hot/hot/cold process.

The geometry of different vessels plays an important role in this process. What volume of each phase is absolutely necessary? What options exist in the pre-phase vessels? Is thorough mixing ensured?

Reducing the temperature of the water phase while simultaneously optimizing the melting temperature of the oil phase can yield very good results depending on machine capabilities. Relevant experiments should be considered in the developmental stages.

If high-melting ingredients are required, comparable results might be achieved with lower concentrations, leading to reduced mixing temperatures. There's also the possibility of using oils with very low melting points to optimize the overall melting temperature.

The emulsifier proportion should be calculated according to the initial phase and support straightforward emulsion formation. In some formulations, this might result in a slightly increased need in emulsifier. This should be taken into account during development and testing scenarios.

The "One-Pot" approach is often discussed nowadays. In this method, all relevant ingredients are added directly and then homogenized or stirred as needed. While this process can be advantageous in production, it requires significant developmental effort and has limitations in terms of raw material selection.

Production is a complex process with many factors to consider. A good understanding of machinery and available preparation equipment by developers, technicians, and production staff promotes optimal use of existing resources and ensures high process reliability.

Rotor-stator mixers in combination with traditional agitators are most commonly used in emulsion production. Direct entry into the homogenizer allows for mixing of hot oil phase and warm or cold water phase below the solidification point in certain constructions. Machine structure and equipment are crucial for optimization. This method requires attention to direct fine dispersion and immediate emulsion formation. If the machine parameters are not conducive, inhomogeneities may occur. Replicating this process in the laboratory is difficult. It's advisable to conduct smaller-scale up steps using corresponding machines.

Examining the consumption of cooling and cleaning water, as well as the use of heating water, can reveal further potential for savings. Particularly in hot/hot variants, the cooling circuit is of critical importance. The amount and temperature of cooling water directly impact production efficiency. Cooling water with an additional cooling circuit significantly reduces production times. Prolonged cooling times during full operation are often observed when multiple machines are connected to the cooling circuit. Often, cooling performance is insufficient, leading to inadequate cooling water supply.

Other influencing factors can include the position of temperature sensors and control settings by automation. Continuous cooling is preferable to step-wise cooling (starting at phase junction and directly activating cooling to 20°C or even 15°C). This requires a correspondingly developed process that only involves additions at low temperatures after phase junction. Ideally, additions should occur immediately after phase junction, simultaneously promoting the cooling process, and additions shortly before product withdrawal.

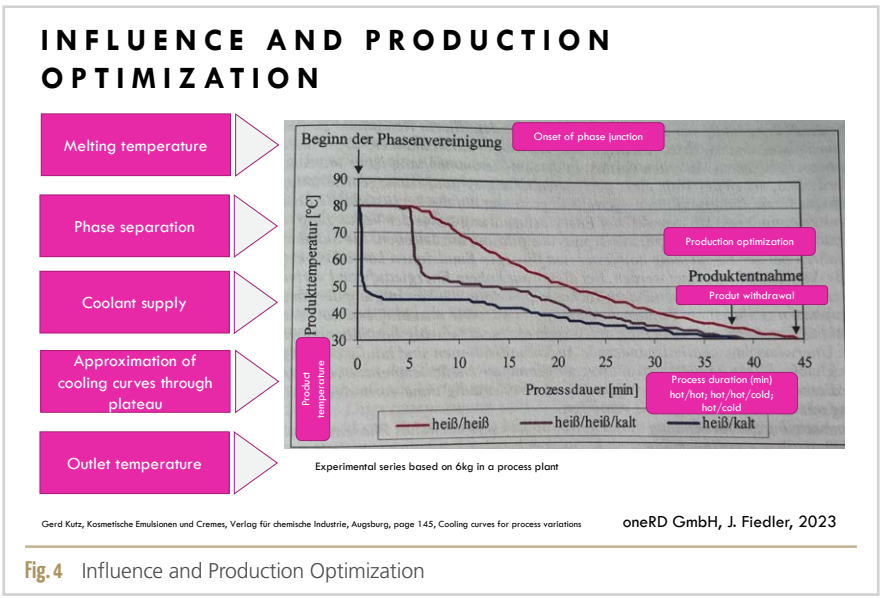


Fig. 4 Influence and Production Optimization

For machines capable of directly incorporating powders through the homogenizer, this approach is particularly suitable for sustainable thickener types. Direct addition after phase junction is often possible, ensuring good mixing even after emulsification. In choosing such a method, air-free delivery is crucial. This can be ensured through appropriate sensors. The water phases do not have to be premixed in the conventional way. This approach can also be useful for emulsifiers that are not fully soluble in the phases.

Hot water lines are a highly efficient means of heating and are preferable to heating in kettles or mixers. In terms of production times, it's advisable to keep the phases as small as possible and select a relatively low temperature for phase junction. Mixing to a colder target temperature significantly affects cooling times. Addition of cold water phase for cooling is also advantageous in the overall process.

Further optimizations related to production infrastructure are possible. Consumption of cooling and cleaning water can be reduced through loops and collection systems, as well as potential cleaning systems. If heating water is used, heat exchange systems on the roof can be employed to reduce energy consumption and thereby aid in emission reduction.

Certain machine manufacturers like Becomix or Symax are capable of providing simulations and calculations for production variants. Depending on the manufacturer, digital twins are already feasible and available today. Direct exchange between machine manufacturers and developers aids in machine understanding and more efficient implementation in production.

In summary, if feasible, cold processing should be the primary choice of method. Hybrid approaches and reduced temperature management can lead to savings of 20% or more **(Figure 4)**. Production capacities can be increased through these measures, generating higher value.

A targeted focus on production efficiency from the early stages of development is crucial. This requires appropriate structures and solid knowledge about machines, raw materials, and process options. Close collaboration between development and production enhances efficient implementation. Multiple steps and loops are often necessary to achieve high optimization. **Figure 5** schematically represents this process flow.

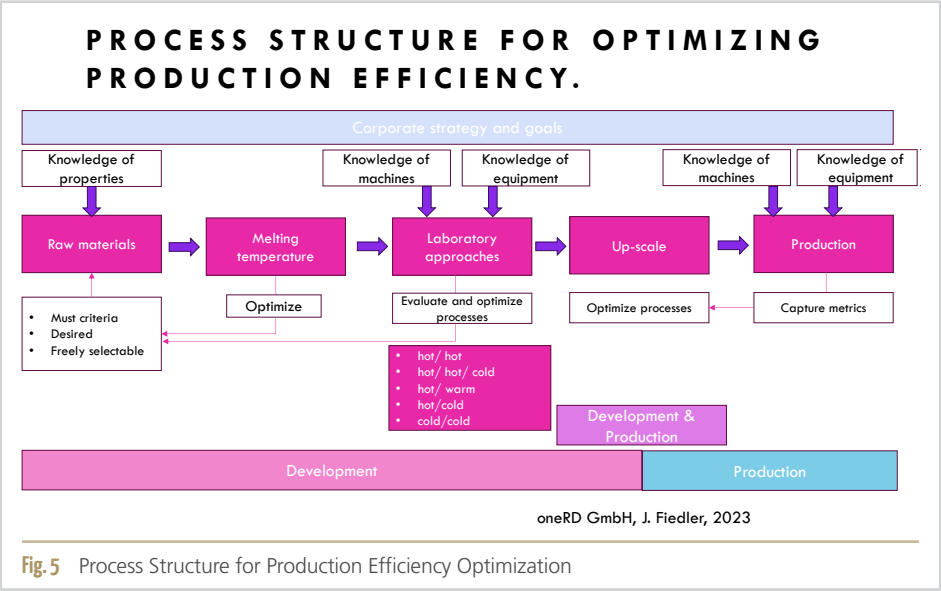


Fig. 5 Process Structure for Production Efficiency Optimization

Methods such as DSC measurements provide valuable insights into formulation profiles and enable targeted and specific approaches in development. Even minor adjustments lead to improvements. To tap into the full potential, a focused approach to process optimization in product development is needed. Capturing consumption data per batch and machine is essential as a basis for setting objectives and metrics. This allows for a direct conversion of CO_2 savings and improvement in sustainability metrics related to bulk production.

Potential exists for many emulsions. Investments in appropriately efficient base formulations form the foundation for improved future production efficiency and sustainability metrics.

Frequently, concerns are raised about the risk of contamination in cold processes or hybrid methods compared to hot processes. Given that productions are conducted under GMP (Good Manufacturing Practices) and appropriate hygiene measures, the quality of raw materials is pivotal in assessing risk. Thus, conducting a risk analysis on the formulation and raw materials during development activities is recommended. Are there raw materials with high microbiological risk? What alternative qualities are available in the market? Can other raw materials be used as alternatives? What preservation options exist?

Overall, optimization in emulsion production offers diverse potential for improving sustainability metrics, efficiency, capacity, and production times. Thoughtful selection of raw materials, processes, and machine characteristics, along with close collaboration between development and production, are key to success. Even minor measures can yield significant improvements. Investments in optimized base formulations aiming for highly efficient production are the cornerstone for progress in cosmetic production with a focus on sustainability and efficiency.

Further information on the topic of energy optimization in emulsion production can be found in the guide "Energy Efficiency in the Cosmetic Industry."

This guide was developed by Prof. Dr. Ludger Fischer and Petra Huber in collaboration with various companies. (*Leitfaden Energieeffizienz in der Kosmetikindustrie | Lucerne University of Applied Sciences and Arts (hslu.ch)*).

author

Judith Fiedler

oneRD GmbH

Wasterkingen | Switzerland

+41 76 51 56 520 | Judith.Fiedler@onerd.ch

Picture © Artem Varnitsin - stock.adobe.com

SOFW 360°

SOFW 360° - All in! is your new **all-inclusive toolbox** when it comes to practical, application-oriented, focused and scientific information from the international household and personal care industry.

One click - all in!

Your benefits at a glance

- **Professional magazine**
  Get 10 issues of SOFW journal digital and/or print.
- **High quality articles**
  Find more than 1,300 professional papers in our SOFW archive.
- **Video presentations & interviews**
  Watch more than 110 recordings in our SOFW video library.
- **How to make a product**
  Access our growing database with over 260 formulations.
- **Science and applied science lectures**
  Get unlimited access to our SOFW eVENTS video presentations.
- **Network of experts**
  Ask questions and connect with our professionals.

Get in touch with us

360@sofw.com

Water-soluble or Not?
A Simple Question Difficult to Answer

J. Venzmer

Solubility in water is an important property of surfactants for many purposes, including surface tension determination and (eco)toxicological studies. Surfactants have been categorized as "difficult to test"; the challenges associated with the determination of solubility in water will be discussed. OECD TG 105 is based on the definition of solubility in water as "saturation mass concentration". For most surfactants, there is no saturation concentration, but rather formation of micelles or other surfactant aggregates. Unfortunately, there is a misconception that surfactant micelles are equivalent to droplets of hydrophobic material. This is not true, as there is a rapid exchange of surfactant molecules between those in a micelle and those present as single molecules in the bulk water – a true thermodynamic equilibrium. In addition, surfactants are able to solubilize hydrophobic substances within their micelles, enhancing their bioavailability.

Introduction

Solubility in water is a crucial property and often a prerequisite for the physicochemical characterization and (eco-)toxicological evaluation of substances; thus, the term "solubility" appears 420 times in the 2635 pages of the REACh document (Regulation No 440/2008) [1,2]. The methods for the experimental determination of water solubility are the OECD Technical Guidelines 105 [3] and 120 [4]. Unfortunately, if taken literally, these guidelines are difficult to apply to surfactants and surface-active polymers. For this reason, surfactants have been listed in an OECD guidance document among the "difficult to test" substances [5]. However, surfactants not really "difficult"; they are just "different" since they do not follow the same rules as non-amphiphilic low MW molecules. Because of their amphiphilic molecular architecture, they have special properties in terms of phase and interfacial behavior, which is why they are crucial ingredients for many applications. Since OECD TG 105 and 120 are the only existing guidelines for assessing the water solubility of chemicals, both customers and regulators require data based on these – unsuitable – guidelines. The challenges involved are discussed in this paper, which will hopefully be useful not only for surfactants, but also for purposes in the field of polymers, including the consideration of polymers as potential microplastics [6–8].

OECD Technical Guideline 105

Both the REACh document [1] and the OECD TG 105 [3] define the term water solubility as the "saturation mass concentration" of a chemical in water at a given temperature. According to OECD TG 105, after a preliminary test, one of two methods should be used depending on the expected solubility: The column elution method or the flask method for solubilities below and above 0.01 g/L, respectively. Typically, the analytical challenge in such procedures is the quantitative determination of the potentially very small amounts of the chemicals being tested. For surface-active substances, however, there is a conceptual challenge: there is no saturation concentration (only one exception: ionic surfactants below the Krafft temperature), and many surfactants are very well soluble in water; most of them are even commercially available as more or less concentrated (30-70 wt%) aqueous solutions.

In the column elution method, the substance to be tested is loaded onto a support, which is then filled into a column. Using a recirculation pump, a defined amount of water is pumped through the column until a saturation concentration is reached. The aqueous phase should be checked for the presence of colloidal matter by light scattering ("Tyndall effect"), as the presence of particles will invalidate the result of the solubility determination. Fortunately, the absence of the Tyndall effect is only required in the column method for substances of low solubility. For the flask method, the guideline only refers to a "clear aqueous phase", without any specification or guidance as to how "clear" should be assessed. If the absence of a Tyndall effect was also required in the flask method, very well water-soluble, micelle-forming surfactants would be insoluble – at all concentrations above the Critical Micelle Concentration (CMC), even though they are marketed as concentrated aqueous solutions and used in water-based surfactant formulations. But: The term micelle is

not mentioned at all in OECD TG 105, so for "normal" hydrophilic surfactants, the OECD TG 105 preliminary test is all that can reasonably be done: Visual observation of highly concentrated surfactant/water mixtures (e.g. 0.1 g of the sample in 0.1 or 0.5 mL of water). And since in most cases there is no sediment, is it really necessary to perform the flask method and do a quantitative analysis (e.g. by HPLC) of the solutions? This would be nothing but recording a calibration curve and a waste of resources.

What is special about surfactants?

Apart from the lack of a saturation concentration, the main reason why surfactants are "difficult" to test is that most surfactants are not "pure" but mixtures of substances with different solubilities. This is not a bug, but an important feature that is either unavoidable from the viewpoint of synthesis and/or essential from the viewpoint of application performance. This inherent "heterogeneity" is caused by either alkyl chain length distributions (such as coco = C8 – C18) or unavoidable homologue distributions of the hydrophilic headgroups of ethoxylates. Another example are surfactants containing a carboxylate group such as Sodium Lauroyl Glutamate, Alkyl Ether Carboxylates or simply Sodium Oleate (a.k.a. soap); these are also mixtures – at intermediate pH values – consisting of the protonated (often insoluble) form and the neutralized (soluble, i.e. micelle-forming) salt form.

Micelles are a soluble state of surfactants

There is a 2019 review on the determination of water solubility of difficult-to-test substances [9]. For whatever reason and without any reference, in the chapter entitled "Scientific Challenges" it has been stated that surfactants that cluster into micelles above the CMC are no longer freely dissolved. Moreover, the opinion has been expressed that micelles "can be viewed as equivalent to the formation of micro-droplets or emulsions of hydrophobic chemicals in water". This statement is in contradiction with basic physical chemistry, and such "alternative facts" should not have made it into a peer-reviewed journal. Even above the CMC, surfactants are well-dissolved from a thermodynamics point of view. There is a rapid exchange of surfactant molecules between those forming the micelles and the free surfactant "monomers" in the bulk phase on a timescale of about 10 µs (for the typical dodecyl chains); such a micelle has exchanged all of its surfactant molecules on a timescale of about 1 ms [10]. This is a real thermodynamic equilibrium and therefore micelles are not at all equivalent to emulsion (micro-)

droplets of hydrophobic chemicals. Moreover, the difference in size between a micelle and an emulsion droplet is at least two orders of magnitude.

Unfortunately, this misconception about micelles has found its way onto poster 1.15PC.3 presented at the SETAC 2020 Conference [11] entitled "Surfactants: Substances of Concern? ECHA's current challenges in safety assessment". The abstract states that in REACh registration dossiers for surfactants, "physico-chemical data are often unreliable, e.g. water solubility is reported without taking into account the critical micelle concentration as the solubility limit, the values are approximated based on visual inspection only". What was described as "unreliable" is the result of performing the preliminary test – by visual inspection, as required by OECD TG 105. The poster also stated that "concentrations above CMC in water do not represent the truly dissolved concentration, i.e. the bioavailable fraction." Scientifically speaking, this can only be considered as "fake news".

Solubilization within micelles

The uptake of pharmacological actives is often facilitated by solubilizers, i.e. hydrophilic surfactants capable of accommodating hydrophobic materials within their micelles – in other words, the hydrophobic actives are made bioavailable with the help of surfactants [12]. Therefore, it is safe to assume that not only the hydrophobic actives, but also the surfactants forming the micelles are bioavailable. Such a solubilization within a micelle is a completely different story than the formation of a comparably macroscopic (several µm sized) emulsion droplet. Also in biodegradation, surfactants help to make hydrophobic materials bioavailable; as a recent example, rhamnolipids have been found to increase the yield of hydrogen from waste activated sludge during anaerobic degradation [13]. And why do microorganisms produce biosurfactants at all? To use hydrophobic materials as a carbon source ("food"), in other words, to make hydrophobic chemicals bioavailable [14].

CMC = Maximum solubility?

As discussed above, from a regulatory point of view, the CMC of a surfactant is often considered to be the maximum solubility – as surfactant monomers. However, for "technical" surfactants, i.e. those containing a mixture of components of different hydrophilicity, the opposite is true: Only above the CMC of the more hydrophilic components, the more hydrophobic components can be solubilized. Consequently, solutions below the CMC may look turbid, which is exactly the opposite of what is expected for regulatory/ecotoxicological purposes. Furthermore, in these cases, the nominal concentration (on the x-axis of the CMC plot) does not represent the concentration of dissolved material. All of this poses a challenge when trying to determine CMCs from surface tension measurements, as discussed in the accompanying paper on surface tension [15].

Another use of CMC values as maximum monomer solubility is to generate the octanol/water partition coefficient log K_{ow}, which was never meant to be used for interfacially active materials such as surfactants and emulsifiers [16]. Using the individual solubilities in water and octanol to calculate a value that allows some conclusions to be drawn about environmental fate seems to be the least of all evils. It turned out that by using the CMC as solubility in water (instead of the "real" macroscopic solubility of e.g. >50%), the calculated values of log K_{ow} somehow agree with those obtained by the slow-stirring method [17].

Example: Associative thickeners

Soluble polymers are not microplastics; accordingly, the final RAC/SEAC opinion on the draft microplastics restriction accepts that a "particle is a minute piece of matter with defined physical boundaries"[6–8]. Also based on this definition, a micelle or any other surfactant aggregate cannot be considered a particle (except for the "linguistic" problem that the result of a Dynamic Light Scattering experiment, which is the method of choice to determine the size of micelles, is a particle size distribution).

The associative thickener with the simplest molecular architecture – PEG-150 Distearate – has already been mentioned in the preceding paper [15]. As a bulk material, this highly ethoxylated ester is a solid due to the melting point of polyethylene oxide (about 68°C); therefore, the question was raised whether this product must be considered to be microplastic or not. Since the rather large and well water-soluble PEO chain (MW 6000 g/mol) is esterified with saturated C18-alkyl chains that crystallize easily, PEG-150 Distearate is not clearly soluble in water on its own. However, in aqueous surfactant formulations, this highly ethoxylated ester can be solubilized. It is then able to interconnect other surfactant aggregates (spherical micelles, worm-like micelles) and thus acts as an associative thickener. Moreover, this function can only be fulfilled if the polymer is in an expanded (soluble!) state and thus able to bridge the distance between the surfactant micelles. Proving the solubility of such soluble polymers is a challenge under current regulations.

Conclusion and Outlook

It would be beneficial if OECD TG 105 on solubility could be applied to surfactants and surface-active polymers. One option would be to write an amendment to include substances that do not have a saturation concentration and to describe micelles of surfactants and surface-active polymers as a water-soluble state. The need to update TG 105 was also one outcome of the recent UBA/Fraunhofer/Ramboll project to evaluate which

hpci

www.hpci-events.com

NOTE THE DATE

HPCI INDIA

MUMBAI | 18-19 JANUARY 2024

HPCI CENTRAL & EASTERN EUROPE

WARSAW | POLAND

25-26 SEPTEMBER 2024

HPCI MIDDLE EAST AND EURASIA

ISTANBUL | TURKEY (DATES TBA)

HPCI Events are the B2B communication platform for emerging and new markets

VINCENTZ

Vincentz Network · P.O. Box 6247 · 30062 Hannover · Germany · hpci@vincentz.net · www.hpci-events.com

OECD guidelines need to be revised [18]. However, such an update is a time-consuming endeavor [19]. For the time being, we have to live with the existing guidelines, but with this paper we wanted to raise awareness of the challenges involved. One final comment: Do we really need to use OECD TG 105 to demonstrate water solubility for those solids that are also marketed as aqueous (e.g. 50 wt%) solutions? Would this not show already water solubility without further testing? And if there was no sediment in the OECD TG 105 preliminary test, a quantitative analysis of the solution in a flask test should be obsolete.

Remark

This paper is a joint effort of members of the CESIO Working Group "Test Methods of Surfactants" and the TEGEWA Working Group "Surface Active Substances": Roland Borner (Chemische Fabrik Schärer&Schläpfer AG), Katrin Wunderlich (Zschimmer&Schwarz GmbH&Co KG), Karsten Holtin (Kolb Distribution Ltd.), Bernat Pi (Kao Corporation S.A.), Arjan Gelissen (Sasol Germany GmbH), Johannes Bookhold (Clariant Produkte (Deutschland) GmbH), Kati Schmidt (BASF SE), Louis Schwarzmayr (Nouryon Surface Chemistry AB), Michael Stapels (Kao Chemicals GmbH) and Joachim Venzmer (Evonik Operations GmbH).

References:

[1] European Commission, "Council Regulation (EC) No 440/2008 of 30 May 2008 laying down test methods pursuant to Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)," Off. J. Eur. Union, vol. 51, pp. L-142/1-739, 2008.

[2] Commission Regulation (EC) No 440/2008, pp. 1–2635, 2019, [Online]. Available: http://data.europa.eu/eli/reg/2008/440/corrigendum/2008-06-03/oj

[3] OECD GUIDELINE FOR THE TESTING OF CHEMICALS 105: Water Solubility.

[4] OECD GUIDELINE FOR THE TESTING OF CHEMICALS 120: Solution/Extraction Behaviour of Polymers in Water.

[5] OECD, "Guidance Document on Aquatic Toxicity Testing of Difficult Substances and Mixtures. Series on Testing and Assessment No. 23 (2nd edition)," Organ. Econ. Co-operation Dev., vol. 23, no. 23, pp. 1–81, 2019, [Online]. Available: https://www.oecd.org/env/guidance-document-on-aquatic-toxicity-testing-of-difficult-substances-and-mixtures-0ed2f88e-en.htm

[6] ECHA, "FINAL Committee for Risk Assessment (RAC) Committee for Socio-economic Analysis (SEAC) Background document," 2020. [Online]. Available: https://echa.europa.eu/documents/10162/5a730193-cb17-2972-b595-93084c4f39c8

[7] European Chemicals Agency, "Committee for Risk Assessment (RAC) Committee for Socio-economic Analysis (SEAC) Background document," 2018. [Online]. Available: https://echa.europa.eu/documents/10162/b56c6c7e-02fb-68a4-da69-0bcbd504212b

[8] ECHA, "FINAL RAC SEAC Annex to Background Document," 2020. [Online]. Available: https://echa.europa.eu/documents/10162/a513b793-dd84-d83a-9c06-e7a11580f366

[9] *H. Birch, A. D. Redman, D. J. Letinski, D. Y. Lyon, and P. Mayer*, "Determining the water solubility of difficult-to-test substances: A tutorial review," Anal. Chim. Acta, vol. 1086, pp. 16–28, 2019, doi: 10.1016/j.aca.2019.07.034.

[10] *A. Patist, J. R. Kanicky, P. K. Shukla, and D. O. Shah*, "Importance of micellar kinetics in relation to technological processes," J. Colloid Interface Sci., vol. 245, no. 1, pp. 1–15, 2002, doi: 10.1006/jcis.2001.7955.

[11] Society of Environmental Toxicology and Chemistry Europe (SETAC Europe), "SETAC Europe 30th Annual Meeting Abstract Book," 2020, p. 370. [Online]. Available: https://dublin.setac.org/wp-content/uploads/2020/04/SETAC-SciCon-Abstract-book_v2.pdf

[12] *Z. Vinarov, V. Katev, D. Radeva, S. Tcholakova, and N. D. Denkov*, "Micellar solubilization of poorly water-soluble drugs: effect of surfactant and solubilizate molecular structure," Drug Dev. Ind. Pharm., vol. 44, no. 4, pp. 677–686, 2018, [Online]. Available: https://doi.org/10.1080/03639045.2017.1408642

[13] *Q. Song, F. Kong, B. F. Liu, X. Song, N. Q. Ren, and H. Y. Ren*, "Insights into the Effect of Rhamnolipids on the Anaerobic Fermentation and Microalgae Lipid Production of Waste Activated Sludge: Performance and Mechanisms," ACS ES T Eng., vol. 3, pp. 438–448, 2023, doi: 10.1021/acsestengg.2c00372.

[14] *A. R. Markande, D. Patel, and S. Varjani*, "A review on biosurfactants: properties, applications and current developments," Bioresour. Technol., vol. 330, no. March, p. 124963, 2021, doi: 10.1016/j.biortech.2021.124963.

[15] *J. Venzmer*, "Determination of surface tension of surfactant solutions from a regulatory viewpoint," SOFW-Journal, vol. 149, no. 10, 2023.

[16] ECHA, Chapter R.7a Endpoint specific guidance. 2017. doi: 10.2823/337352.

[17] *G. Hodges et al.*, "A comparison of log K ow (n-octanol–water partition coefficient) values for non-ionic, anionic, cationic and amphoteric surfactants determined using predictions and experimental methods," Environ. Sci. Eur., vol. 31, no. 1, pp. 1–18, 2019, doi: 10.1186/s12302-018-0176-7.

[18] Reviewing OECD Test Guidelines. https://rev-otg.com

[19] OECD, Guidance Document for the Development of OECD Guidelines for Testing of Chemicals, vol. 1. Paris: OECD Publishing, 2002. [Online]. Available: https://doi.org/10.1787/9789264077928-en

author

Joachim Venzmer

Evonik Operations GmbH

Goldschmidtstr. 100 | 45127 Essen | Germany

joachim.venzmer@evonik.com

sofw journal
Home & Personal Care Ingredients & Formulations
powered by SOFW

Nearly 150 Years of Experience

The SOFW Journal has been published since 1874. It provides extensive information regarding formulation of cosmetics, body care, detergents, fragrances and chemical specialties.

Topics

New raw materials and ingredients, biotechnological developments, compatibility, formulations, legislation, methods of testing, branch and market news.

Audience

Formulators, chemists, research and development, laboratory staff, marketing, management and students.

Languages

At present the SOFW Journal is published in English and German. This ensures that all the information is available to the readers worldwide.

www.sofw.com

"Brave New World" – What Contribution Can the Cosmetics Industry Make?

C. Hein, L. Schlüter, K. Nessbach
SEPAWA® Specialist Group Cosmetic Applications and Technologies

The SEPAWA® Specialist Group Cosmetic Applications and Technologies (CAT) organized a lecture event which took place on 9th and 10th May at the Maritim Hotel Würzburg, under the theme "Brave New World" – What Contribution Can the Cosmetics Industry Make?

As usual, the event began with an accompanying program the day before. A sunny city tour provided interesting insights into the history of Würzburg and the opportunity to see its beautiful buildings. This was followed by a visit to the Kneipp store and the mandatory glass of wine in the sun set on the "Alte Mainbrücke". The day ended successfully with a shared dinner at the "Alte Mainmühle", which provided a wonderful opportunity for attendees to engage in conversations.

The main event on the following day focused on the challenges currently facing the cosmetics industry, with a particular emphasis on sustainability and factors that have the potential to positively influence the industry. These included energy optimization in cosmetics production and the implementation of effective raw material recycling strategies.

Sarah Frech from BEAUTYSTREAMS opened the lecture event with her presentation on Intersectional Beauty. Intersectional Beauty is based on the concept that each consumer has a variety of different needs that intersect with one another. This leads to the challenge that there are almost as many consumer goals as there are individuals. Today's consumers expect a more personalized approach, taking into account the many facets of cultural, geographical, spiritual, social, and genetic influences. In this context, there are market opportunities for the development of products that combine modern science and traditional medicine or consider lifestyle, environment, as well as skin and hair types. Moreover, products can be tailored specifically to address the needs of older age groups or unique requirements.

Keynote speaker Anne Fierhauser provided a fascinating insight into the world of face reading. She captivated and inspired the audience with new perspectives derived from ancient teachings. Her presentation provided us with an insight into her expertise and her unique approach to face reading. Based on individual facial features, Anne Fierhauser creates in-depth personality analyses, identifies strengths and potentials, and helps corporations and companies achieve sustainable success.

In a tandem presentation, **Isabel Simon** from **Kneipp GmbH** and **Prof. Dr. Ralf Stürmer** from **Psyrecon GmbH** presented interesting findings on the aromacological product performance and psychophysiological effectiveness of a citrus-scented shower product based on essential oils. Skin cleansing can have a psychophysiological dimension of effectiveness beyond the mere removal of dirt, especially due to the aromacological effects on emotions and well-being. To investigate these psychophysiological effects of a citrus-scented shower product, Simon and Stürmer developed a study design to capture the aromacological effects under "realistic" conditions using Objective Emotional Assessments (OEA). This involves the simultaneous measurement of electrodermal activity, electrocardiogram, electroencephalogram and electromyogram. The results showed that the product was rated by the participants as 'invigorating', 'refreshing', 'stimulating', 'activating' and 'mood enhancing'. The activating and stimulating effects of the citrus-scented shower gel were also confirmed by the OEA measurements.

Dr. Kerstin Effers from the **Consumer Center** (Verbraucherzentrale) gave a presentation on more sustainable cosmetics, consumer protection, and environmental protection. The cosmetics industry can play an important role in several of the United Nations' sustainability goals, such as promoting sustainable consumption and production, implementing climate change mitigation measures, and preserving and protecting marine life. The trend towards more sustainable, packaging-free cosmetics is also evident in the growing popularity of solid cosmetic products. The solid alternatives for shampoos, shaving soaps, deodorants, body butters and more have now made their way from zero-waste stores to drugstores and supermarkets. Because of their solid form, they require less packaging material, are more energy efficient to produce and have a lower impact on wastewater resources. The Consumer Centre's environmental advice service regularly runs cam-

paigns to educate consumers about environmental protection and waste reduction in this area.

Dr. Andreas Reinhart (REINHART Rechtsanwälte Partnerschaft mbB) gave a presentation titled "*Environmental Advertising for Cosmetic Products – Legal Boundaries*" in which he addressed the current developments at the EU level. The European Commission has been dealing with the issue of greenwashing, which refers to misleading advertising in the environmental sector. The current legal framework includes Article 20 of the EU Cosmetics Regulation, which sets out a general prohibition on misleading advertising for cosmetics, as well as the Cosmetic Claims Regulation 655/2013, which only sets out general criteria. In addition, there is the EU Ecolabel, which has been extended to 'leave-on' products and provides an incentive for industry to work more with it, provided that specific criteria such as biodegradability and environmentally friendly packaging are met. However, labels such as 'carbon neutral' or 'CO_2 neutral' are currently much more common in the market. Consumers are often unaware that part of the carbon footprint is offset through compensation or the purchase of carbon credits. Considering this issue, the European Commission proposes to amend Directives 2005/29/EC and 2011/83/EU

Lecture room, Maritim Hotel in Würzburg

to prohibit opaque and unreliable sustainability seals or information tools. It is proposed to include this in Annex 1 of the Directive and to add a blacklist of such bans. In addition, at the end of March, the draft Green Claims Directive was presented, which complements the EU Commission's draft directive amending the UCP Directive.

Judith Fiedler demonstrated in her presentation "*Unlocking the Potential of Energy Optimization in Cosmetic Production*" how these climate goals can be implemented in cosmetic production. The cosmetics industry consumes significant amounts of energy, and the production of cosmetic emulsions contributes significantly to this consumption. Energy optimization starts with the development process of cosmetic products. By choosing energy-efficient ingredients, implementing environmentally friendly production methods and using suitable testing methods, the energy demand to produce cosmetic emulsions can be reduced. It is important to generate more knowledge about the fat phase, such as the melting point and solidification point. Conscious consideration should be given to the choice of raw materials and how volume proportions can be optimized. In particular, the water phase has an unfavorable energy profile during heating and cooling.

Marc Cöslin from **ProXES** built on the topic of energy saving in his presentation "*Energy Saving with Natural, Cold-Processed Emulsions*".

In this context, he presented various manufacturing methods for emulsions using vacuum process systems and emphasized the advantages of cold processing, to reduce energy costs and CO_2 emissions. The technological implementation of cold processing not only offers ecological benefits but also enables efficient utilization of time resources that can be allocated to other production approaches. To illustrate the differences between hot and cold processing, Cöslin presented an example. It became evident that hot processing consumed 87 kWh of energy and took 106 minutes, whereas cold processing only required 6 kWh of energy and 36 minutes. These figures highlight the significant potential for savings associated with cold processing compared to conventional hot processing.

The trend is increasingly moving towards the cold processing of products as manufacturers are recognizing that this efficient method allows them to reduce energy costs, decrease CO_2 emissions, and meet the rising consumer demands.

Election SEPAWA® e.V. Specialist Group Cosmetic Applications and Technologies (CAT)

On June 16th, the board election of the SEPAWA® e.V. Specialist Group Cosmetic Applications and Technologies (CAT) took place, led by **Holger Plate**.

The members of the previous board were discharged, and the newly elected board, unanimously chosen, consists of the following individuals: **Dr. Kristin Neßbach**, the former secretary, has been promoted to the position of 1st **Chairwoman,** replacing **Astrid Wulfinghoff**. **Sandra Iris Spiegelberger** and **Dr. Leslie Schlüter** remain in their positions as 2nd **Chairwoman** and **Treasurer,** respectively. The new **Secretary** is **Christian Schmidt**.

The CAT Specialist Group would like to take this opportunity to express its sincere gratitude to **Astrid Wulfinghoff,** a long-time member who led the Specialist Group as 1st Chair for six years. Her dedication and leadership significantly contributed to the success of CAT.

CAT special group members (left to right): Nicola Kricsfalussy, Sopna Thill, Leslie Schlüter, Carolin Hein, Astrid Wulfinghoff, Ralf Kuschnereit, Sandra Spiegelberger, Christian Schmidt, Alina Maier, absent: Kristin Nessbach

Carbon dioxide is generally considered a pollutant and plays a significant role in climate warming. In this context, new possibilities arise for fermentation. With the help of an innovative biotechnological process, valuable raw materials can be obtained from CO_2. This technology, also known as CO_2 recycling, opens a new chapter in the circular economy. **Bernd Söllner** from **Mibelle** highlighted in his presentation the potential of this technology. Through fermentation and biocatalysis, bacteria can be cultivated in bioreactors to capture CO_2 from the air and convert it into valuable products. This innovative approach allows for the integration of CO_2 into a cycle and ensures sustainable utilization. In addition to the production of basic materials such as ethanol, CO_2 recycling also offers new possibilities in the field of packaging through the production of PET (polyethylene terephthalate). By considering CO_2 as a valuable resource, CO_2 recycling can help reduce the negative impacts on the climate and promote a sustainable cycle. The development and application of this technology opens new perspectives for a future-oriented and resource-efficient economy. Thus, CO_2 recycling represents an important step towards a sustainable and climate-friendly future.

The presentation by **Willi Moor** from **Döhler** titled "*From Waste to Valuestream*" addresses the various by-products and waste streams in the food industry, as well as the technologies and measures for extracting new raw materials for the cosmetics industry through juice production.

Through targeted processing and treatment technologies, these by-products are transformed into valuable raw materials. The focus is on a complete plant upcycling process.

For example, plant-based color pigments, hydrolates, milled fibers, or flavored water are produced, which are used in different applications.

Authors

Carolin Hein, Dr. Leslie Schlüter, Dr. Kristin Nessbach
SEPAWA® Specialist Group Cosmetic Applications and Technologies

Contact:

SEPAWA® e.V. Office
Dorfstraße 40 | 86470 Thannhausen | **Germany**
E-Mail: office@sepawa.de


Jasmine Shah

CLARIANT

Plantasens Pro LM: A Versatile Emollient Ideal for Skincare, Suncare and Color Cosmetic Applications

Interview with **Jasmine Shah**, Marketing Manager Skin Care at **Clariant**

Why are emollients essential in personal care products, what is their role?

Emollients have long been recognized as indispensable ingredients in personal care products for their ability to soften the skin and enhance moisture retention. Traditionally, emollients have been valued for their role in providing gentle moisturization and maintaining skin. However, demands on emollients are evolving. Consumers increasingly seek skincare benefits across their beauty routines – so emollient use is becoming increasingly important for sun care and color cosmetic formulations. This "skinification" trend has driven the integration of skincare into diverse applications, such as sunscreens with incorporated hydrating ingredients and foundations with added skincare benefits.

Our latest launch, Plantasens Pro LM stands out as a versatile emollient that has found its place in skincare but also in makeup and sun care formulations, and perfectly embodies the spirit of skinification across applications. In addition, Pro LM provides formulators with a choice of excellent emollience without compromising on environmental sustainability.

Why does Plantasens Pro LM stand out compared to other emollients on the market?

With its unique attributes, Plantasens Pro LM caters to the demands of modern beauty formulations, offering a luxurious and caring skin feel, making it an excellent choice for rich and creamy moisturizers. It's also fully customizable – being compatible with several commonly used waxes, oils and oleogels, which broaden its application scope. This seamless ability to blend with a variety of other ingredients is particularly important to ensure that it is not limited to thicker formulations and is also suitable as an emollient for use in suncare formulations.

For use in the realm of sun care, Plantasens Pro LM shines as an ideal companion for organic UV filters. Its outstanding compatibility ensures the formulation remains stable and effective in protecting the skin from harmful UV rays. Additionally, its superior pigment wetting and dispersing ability makes it valuable in mineral suncare formulations, as well as color cosmetic applications. Overall, Plantasens Pro LM is a great choice of emollient for use in moisturizing foundations or tinted moisturizers.

Beyond its exceptional performance, what are the additional benefits of Plantasens Pro LM?

Plantasens Pro LM champions environmental responsibility. Sourced from Palm kernel oil and castor oil, and available in RSPO grade, this emollient has a Renewable Carbon Index (RCI) of 100%. Additionally, it is readily biodegradable according to OECD 301B standards, reflecting Clariant's commitment to minimizing environmental impact. As a COSMOS and Natrue-certified ingredient, Pro LM is also a great choice for formulators looking to create certified formulations.

Plantasens Pro LM stands as a testament to the evolution of emollients in the beauty industry, meeting the demands of the skinification trend and catering to the ever-expanding skincare, makeup, and suncare markets. Its luxurious feel, compatibility with various ingredients, and exceptional performance make it a reliable choice for formulators seeking to create innovative and versatile beauty products. With Plantasens Pro LM, the journey to develop cutting-edge formulations that deliver both beauty and skincare benefits becomes even more promising.

www.clariant.com

Reach your target group and start your marketing with our various advertising options:

SOFW journal

- ✔ **Advertisements**
- ✔ **Articles**
- ✓ Advertorials
- ✓ Interviews
- ✓ Product Launches
- ✓ Formulations
- ✓ Job Offers
- ✓ Promo Package

SOFW website

- ✔ **Banners**
- ✔ **Overlay Ads**
- ✔ **Interviews**
- ✔ **Media Library**
- ✔ **Product Launches**
- ✓ Formulations
- ✓ Company News
- ✓ Job Offers

Newsletters, E-Shots & Social Media

- ✔ **Banners**
- ✔ **Custom Mails**
- ✔ **Social Media Campaigns**
- ✓ Articles
- ✓ Advertorials
- ✓ Interviews
- ✓ Industry News

Ask us for detailed media data: advertising@sofw.com

SOFW SOFW 360° sofw journal SOFW 7 SOFW eVENTS

Driving Growth and Synergy: Summit Cosmetics Europe's Activities and Strategic Partnerships

SUMMIT COSMETICS

Interview with **Lionel Rey,** Sales & Marketing Director, **Summit Cosmetics Europe**

Following the merger-acquisition in 2022 of the Personal Care division of Summit Pharmaceuticals Europe (SPE) in Germany by SACI-CFPA, a major French player in the distribution of ingredients for the cosmetics industry for decades, Summit Cosmetics Europe was created in April 2023 to harmonize the activities of Summit Cosmetics Corporation division in Europe. Lionel Rey, the company's Sales & Marketing Director, explains his vision.

Can you describe Summit Cosmetics Europe's activities?
This merger-acquisition enables us to be recognized as a European distributor and to consolidate our ingredients offering by pooling our market knowledge and expertise. The creation of the Summit Cosmetics Europe identity is part of a process to homogenize the activities of the Summit Cosmetics Corporation, so that all sister companies in the cosmetic division can benefit from a global network of suppliers, process innovation and operational excellence, with the aim of bringing value to our customers.


Lionel Rey

For more than two decades, Summit Cosmetics German Branch, formally SPE Dusseldorf Branch, has been focusing on providing essential products such as UV filters, solvents, and other vitamins to the industry. The sales and promotion strategy has grown up and is now based on two different approaches: a commercial offer with a highly competitive portfolio, and technical offer with a variety of specialty and semi-commodity ingredients which requires the help of technical experts in skin biology and formulation.

Guided by our global support teams (marketing, application laboratory and regulatory), we are providing cutting edge & unique service to the European cosmetic Industry. In addition, we are building a solid and sustainable presence on the market by carefully selecting tomorrow's suppliers and products by always seeking more naturality and more sustainability.

You recently shared information about your EcoVadis Score, could you tell us more about your CSR Approach?
For more than ten years, we have been implementing sustainable and ethical practice within our organization. As a matter of fact, we have been awarded with Gold Status from EcoVadis (Score from 75 to 76 in 2023). We always challenge our suppliers to provide us with more information about their actions and we nourish them with our feedback and requirements from our clients & partners who are our drivers with regards to sustainability.

We are also looking further down that road when it comes to our supply strategy, we select and import products with a lower environmental impact. In our laboratory, we help our clients with the expertise about our raw materials but also develop and create green formulas.

You just mentioned an application laboratory, can you explain what kind of product you design?
Our laboratory is working as a support for our clients and as an innovation expert as we are closely collaborating with our sourcing team to unveil new ideas, concepts, and future trends for our customers. Since long, we have been working on innovative concepts but also on the replacement of the most polluting ingredients that are currently on the verge of being banned.

Moreover, we regularly participate to innovation contests across Europe, especially in France, where we have been awarded two years in a row with the most innovative & sustainable formulas.

You have recently expanded your ingredients portfolio by signing distribution agreements for Europe with two suppliers. Can you tell us more?

Indeed, our approach to be working with our suppliers is based on solid, long-term relationships. Some of our partners have been key players in our supply chain for over twenty-five years. This long history of working together testifies to the mutual trust and satisfaction we have developed over the years. Our expansion enables us to strengthen our ties with our suppliers and, what's more, extend our distribution rights for the European market. So recently, we expanded our portfolio for Europe with: AURORIUM HOLDING L.L.C. which is a specialized supplier of cosmetic ingredients. Their expertise in this field enables us to enrich our cosmetics offering with natural, high-quality ingredients derived from this plant source. Castor oil-derived ingredients are renowned for their moisturizing, nourishing, and regenerating properties, making them essential elements in many cosmetics formulations. Quality, traceability, and sustainability are key values for our company, and we are delighted that our partners share this vision. We also expend our portfolio with JIANGSU TRAUTEC MEDICAL TECHNOLOGY CO., LTD. which is our brand-new partner, specialized in collagen. This R&D biotech driven company is providing us bio-fermented recombinant human collagens, a worldwide innovation. Their collagen range is completely biocompatible as the products optimize the high bioactive amino acid sequence of natural human collagen. This partnership allows us to boost our portfolio of bio fermented actives and supply high quality, trendy products to our customers.

Can you share your medium-long term objectives related to you European Extension?

We are able to supply and deliver ingredients across Europe thanks to our three logistic partners located in France, Germany, and the United Kingdom and we distribute 22 suppliers through Summit Cosmetics Europe – German Branch, based in Düsseldorf.

We would like to keep on growing within these markets thanks to the presence of our experienced teams.

We are investing, developing, and increasing our salesforce in this sense and our long-term goal is to have local teams in each European country in order to promote our partners to local customers and strengthen our relationship with multinational companies with their R&D centers and production facility globally.

www.summitcosmetics-europe.com

index of advertisers

Publishers´ Ads

imprint

Organ
SEPAWA (Vereinigung der Seifen-, Parfüm- und Waschmittelfachleute e.V.)

Editor in Chief
Robert Fischer | robert.fischer@sofw.com

Editorial Content
editorial@sofw.com

Advertising
advertising@sofw.com

Subscriptions
subscription@sofw.com

Publisher
Verlag für chemische Industrie H. Ziolkowsky GmbH

Print
Holzmann Druck GmbH & Co. KG
Gewerbestraße 2 | 86825 Bad Wörishofen
Germany

Issues
10 issues per year + scheduled special issues

Address
Verlag für chemische Industrie H. Ziolkowsky GmbH
Dorfstr. 40 | 86470 Thannhausen
Germany

Phone
+49 8281 79940-0

Fax
+49 8281 79940-50

Email
vci@sofw.com

Internet
www.sofw.com

Advertisement Rates, See Media Info
www.sofw.com › SOFW journal › Mediadata

Subscription, Prices
Print & Online Subscription
› EUR 260.00 (+ postage, + VAT where applicable)

Online Subscription
› EUR 260.00 (+ VAT where applicable)

Price/Issue
Germany: EUR 26.17 (+ postage, + VAT where applicable)
Other Countries: EUR 26.17 (+ postage, + VAT where applicable)

Picture Credits
Cover: ©Wayhome Studio, Adobe Stock

149th Volume: SOFW journal Soaps, Oils, Fats, Waxes
96th Volume: Containing Sections for Cosmetics, Aerosols and Perfumery
119th Volume: International Journal for Applied Science in the Chemical Industry

SC GROUP 斯拜科

Good Quality Comes From Qualified Materials

PEPTIDE MEISTER

PROFESSIONAL PEPTIDE MANUFACTURER

WEBSITE

SPEC-CHEM COPPER PEPTIDE SERIES

Copper peptide outstanding effect in skin care approved by in vitro & in vivo tests

√ Signal peptide & carrier peptide

√ Promote wound healing & repair damaged skin

√ Improve skin elasticity and firm skin

Solution

SpecPed® GHK-Cu (0.1%)
Product code: 13500603

SpecPed® GHK-Cu (1.0%)
Product code: 13500608

COMING SOON

SpecPed® GHK-Cu OS (0.1%) (Oil Soluble)
Product Code: 13500616

Powder

SpecPed® GCu11P
Product code: 13000400

SpecPed® GCu21P
Product code: 13000300

We are happy to meet you at upcoming events

society of cosmetic chemists 25–26th, Oct · Long Beach, CA Booth No.: 444	SEPAWA CONGRESS 25–27th, Oct · Berlin, Germany Booth No.: C466	interCHARM (30 YEARS) 25–28th, Oct · Moscow, Russia Booth No.: B23
in-cosmetics asia 7–9th, Nov · Bangkok, Thailand Booth No.: J40	SCS Formulate 14–15th, Nov · Coventry, UK Booth No.: 1023	COSMOPACK ASIA 14–16th, Nov · HK, China Booth No.: 10-N06
Making Cosmetics 22-23th, Nov · Milano, Italy Booth No.: 731		