doi:10.2533/chimia.2025.578 Chimia 79 (2025) 578–579

Conference Report

The 17th Freiburger Symposium – A Short Review

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'*Sustainable Chemistry – from R&D to Manufacturing*', this was the title of the 17th Freiburger Symposium, held on April 3–4, 2025, at the School of Engineering & Architecture Fribourg. This biennial event provides a platform for chemists and chemical/process engineers active in process development and production to engage in professional training and networking. The symposium is organized by the SCS Division of Industrial & Applied Chemistry (DIAC). The meeting featured a diverse array of speakers who presented their latest research and innovations in sustainable chemistry, always with a focus on industrial application. This industrial focus coupled with embracing current and future trends and innovations in evolving fields like digitalization and AI are the salient feature of the Freiburger Symposium series.

The program addressed the following key themes and was split into four Sessions.

1) R4 (Reduce, Reuse, Repurpose, Recycle)
2) Manufacturing Excellence
3) Sandmeyer Award Lectures
4) Green Process Chemistry

We are proud to have attracted more than 110 participants and around 20 posters. In line with the industrial application focus, the conference is constantly attracting exhibitors showcasing new technologies and equipment innovations relevant to chemists and engineers. The attendees used the platform for networking during the coffee or lunch breaks, and around the impressive array of posters and exhibitors' booths.

The first day started with a welcome address by Dr. Niklaus Künzle (Lonza AG), President of the DIAC and the symposium chairs, Dr. Roger Marti (HEIA-FR), and Dipl. Ing. Urban Jenelten (dsm-firmenich). ***Dr. Brian Schwegler*** (Lonza AG) discussed the importance of reducing the carbon footprint in the pharmaceutical industry through innovative solvent recovery methods from a CDMO perspective. He highlighted Lonza's commitment to green energy, green solvents, and waste reduction, emphasizing the regeneration of over 10,000 tons of solvent per year as a key strategy for sustainability. ***Dr. Lynda Si-Ahmed*** (Metalor Technologies SA) and ***Frank Bühler*** (Bayer CropScience Schweiz AG) presented their work on the circular economy for precious metals catalysts in a tandem presentation. They showcased Metalor's full loop service for precious metal recycling, which features palladium recycling rates up to 96%, offering improved sustainability and cost-effectiveness. An example from Bayer Crop Science highlighted the recovery of palladium *via* a scavenger process and the need to consider all process unit operations to maximize the overall recovery yield. ***Dr. Sebastiano D'Angelo*** (Syngenta Crop Protection AG) introduced Syngenta's early-stage framework for quantifying climate impacts of new processes for active ingredients. He explained how their web-based software supports life cycle assessments, enabling process chemists and engineers to model different design options and make informed decisions to reduce environmental impacts. ***Marlies Moser*** (Fluitec AG) presented innovative flow reactor and mixing technology during the exhibitor talk. ***Prof. Philippe Schwaller*** (EPFL Lausanne) and ***Dr. Raphael Bigler*** (F. Hoffmann-La Roche AG) showcased the collaboration between the Laboratory of Artificial Chemical Intelligence (LIAC) at the EPFL and Roche's High-Throughput Experimentation (HTE) team in Process Chemistry. They demonstrated how combining HTE with data science tools optimizes chemical processes, leading to more informative and enhanced screening designs through the development of the Minerva ML optimization workflow. ***Matteo Scalabrino*** and ***Raphael Pochard*** (Syngenta Crop Protection AG) discussed the synergy between manufacturing excellence and sustainable manufacturing at Syngenta. They highlighted the company's commitment to reducing greenhouse gas emissions and optimizing energy consumption, material utilization, and process control to achieve significant improvements in production performance and environmental impact. ***Jorge Gamarra*** (Holcim Technology) explored the role of digital technologies in optimizing cement plant maintenance. He emphasized how advanced sensors, data analytics, and real-time monitoring enhances machine performance, reduces downtime, and extends equipment lifespan, leading to higher efficiency and reliability in the cement industry. This presentation allowed the participants an 'out of the box' view on how 'Maintenance Excellence' outside the chemical industry in a large volume, continuous processes and large capital industry is dealt with. The first day was concluded by the keynote lecture by ***Jürgen Wieland*** (Novartis Pharma AG). Mr. Wieland zoomed in on environmental sustainability in pharma, focusing on challenges and opportunities beyond green chemistry. He presented Novartis' approach to sustainable product design, the set-up of an environmental lifecycle assessments (LCA) standard for pharmaceuticals, highlighting the need for effective industry collaborations to address carbon footprint reduction in clinical trials. The first day was concluded by the traditional conference dinner which provided further opportunities for interaction.

The 2nd day started with honouring the Sandmeyer Awardees 2024 and 2025 by providing a platform for their respective lectures. ***Prof. Urs von Gunten*** (EPFL, Eawag) and ***Dr. Christa McArdell*** (Eawag) represented the Sandmeyer Award 2024 and presented their research on advanced wastewater treatment by ozonation. Synthetic organic compounds contaminating water pose a significant threat to ecosystems and human health, especially if the water is used for drinking or food production. They discussed the options and limitations of activated carbon treatment and ozonation for micropollutant abatement, emphasizing its efficiency and biological effects in protecting aquatic ecosystems. Data were shown from pilot- and full-scale applications. The 2025 Sandmeyer Award team was represented by ***Dr. Stephan Bachmann*** (F. Hoffmann-La Roche AG). He described the development of the commercial manufacturing process for divarasib, a potent KRAS G12C inhibitor. Dr. Bachmann emphasized the first example of a highly atroposelective Negishi coupling *via* a continuous process eliminating the need for cryogenic reaction conditions at manufacturing scale, which significantly improved yield (6-fold) and reduced process mass intensity (20-fold). ***Prof. Eva Hevia*** (University of Bern) discussed the use of sustainable polar organometallics for arene functionalization and catalysis. She showcased recent developments in

using organosodium and organopotassium reagents as more sustainable alternatives to organolithium compounds, demonstrating their superior reactivities and applications in selective C-H metalation and catalysis. ***Dr. Tobias Brütsch*** (Dottikon ES) and ***Dr. Stephan Rummelt*** (F. Hoffmann-La Roche AG) lead through the evolution of the commercial manufacturing process for inavolisib, a selective PI3Kα inhibitor. They highlighted the final robust and scalable synthesis route, including key Cu-catalyzed CN-coupling reactions and new route to the chiral difluoromethyl oxazolidinone, relying on a diastereoselective Grignard addition and a Tamao-Fleming oxidation. Broad sourcing knowhow and the wise choice of commercially available starting materials were key elements for the successful route design and development. ***Dr. George Lem*** (dsm-firmenich) provided a brief and scientifically entertaining survey of recent dry woody and ambery odorants. He discussed the importance of maximizing performance-to-cost ratios in perfumery applications and minimizing environmental impact, showcasing the discovery of ultra-powerful cedrane-based molecules with excellent cost-performance. The 17th Freiburger Symposium was concluded with a fulminant lecture by ***Prof. Siegfried Waldvogel*** (Max-Planck-Institute for Chemical Energy Conversion) exploring the direct use of electrochemistry for generating reactive intermediates in organic synthesis. He highlighted the advantages of electricity-driven conversions, including superior energetic balance, scalability (as well compared with photochemistry), and minimal reagent waste, demonstrating the potential for fast optimization and scale-up. Prof. Waldvogel underpinned the significance and applicability of electrochemistry by showing several new approaches to otherwise difficult-to-synthesize classes of compounds, *e.g.* N-oxides of quinazolinones. To achieve sustainable results, electrode materials, reaction mechanisms including intermediates have to me mastered. An example like the degradation of Kraft lignin, a 150 Mio. ton by-product of the paper industry, to vanillin highlighted the importance of a scalable isolation procedure by using a resin thereby circumventing large amount of aqueous neutralization waste streams.

The symposium concluded with the Best Poster Award Ceremony (Fig. 1). Congratulations went to Vincent Freiburghaus (University of Zurich, '*Novel bio-based solvents for SPPS*'), Pauline Daul (HEIA Fribourg, '*Keratin Based Biosorbent for Chemical Waste Treatment*'), and to Fabio Casanova (dsm-firmenich, '*Zeolites-based catalysis for efficient alcoholysis of epoxides for the manufacture perfumery ingredients*').

Received: May 17, 2025

Fig. 1. Poster Award winners Fabio Casanova, Pauline Daul, and Vincent Freiburghaus with Dr. Andrea Sting (left, DIAC), Dr. Niklaus Künzli (second from right, DIAC), and Dr. Richard Smith (right, *Helv. Chimica Acta*). (Photo by S. Abele).