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Conference Report

The 16th Freiburger Symposium – A Short Review

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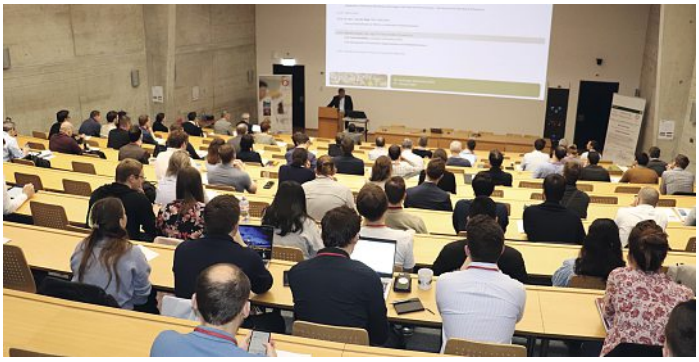
The 16th Freiburger Symposium was held on the 27th and 28th April 2023. The traditional, bi-annual Freiburger Symposium is organized by the DIAC, the Division for Industrial and Applied Chemistry of the Swiss Chemical Society. It was an insightful gathering of leading experts, researchers and professionals from academia and various sectors of the Swiss chemical industry. The event aimed to share and explore innovative approaches, technological advancements and sustainable practices in the field of industrial chemistry applied in real-world industrial production. Unlike the 15th Freiburger Symposium in 2021, this year we were again able to meet in-person offering to all participants a platform to exchange and network.



Opening of the Symposium in the big lecture hall at HEIA-FR (Photo by David Spichiger, SCS).

Over the last few years, the Freiburger symposium has explored diverse science fields which are all at the heart of the industrial chemical industry. The most recent ones include: Green Chemistry, Innovative application of catalysis or Industrial & Applied Chemistry 4.0. The central theme has always been to present and share subjects looking at Current and Future Trends in Chemical Production, focusing on the activity space relevant for chemical industry in Switzerland.

The theme of the 16th edition of the Freiburger Symposium followed the same concept: 'From Lab to Industrial Application – Trends and Innovation in Process Chemistry and Technology'. The program has been put together in a joint effort by all the members of the DIAC board with the intention to illustrate where the chemical industry in Switzerland, Europe and beyond is today and where it is heading.

The program addressed the following key themes and was split into several blocks:

1) Catalysis – New developments towards a sustainable and green chemical production
2) Innovative (Downstream) Processing Technology & Process Intensification
3) Keynote Lecture by Prof. David MacMillan, Nobel Prize Winner in Chemistry 2021 and Professor at the University of Princeton (USA)
4) The traditional lectures of the Sandmeyer prize winners of 2022 and 2023
5) Sustainability & Process Optimization – Illustration of industrial practices

One central theme of the symposium as well as today's industrial chemical production is *sustainability*. Right in the heart of sustainable, green chemical production is catalysis; a critical platform to increase the yield and selectivity, to minimize waste generation as well as energy consumption and allowing thereby to develop eco-friendly processes. The four presentations of this section illustrated the breadth of the field and its critical importance for the chemical industry.

Dr. Michael Dieckmann from Syngenta presented a photochemical C–N oxidative coupling of a functionalized pyridazinone from an initial concept in the lab *via* a screening on ml scale to the development of a process on pilot scale (1.2 m^3). The reaction was mediated by visible light and promoted by a heterogeneous catalyst. The following contribution by ***Dr. Pascal Miéville*** from the EPFL in Lausanne, showcased an inspiring and certainly thought-provoking approach on how the SwissCat+ project aims to accelerate the discovery and optimization of new catalysts in a data driven, autonomous research infrastructure. The completely automated, integrated and data driven project led to the set-up of a laboratory which has very little in common with what we typically refer to thinking of a (chemical) laboratory. Yet another aspect of catalysis and one which is gaining more and more traction is bio-catalysis. ***Dr. Thierry Schlama*** presented how bio-catalysis was implemented and how it is gradually playing a more important role at Novartis. The contribution illustrated the impressive evolution of this technology at Novartis from the early days applying enzymes as catalysts to the design and optimization of the selectivity as well as the performance of biocatalysts with advanced enzyme engineering tools today. The last presentation in the first section by ***Dr. Kathrin Junge*** from the Leibniz-Institute of Catalysis, showcased how academia is working on new and improved homogenous non-noble metal-based catalysts covering a wide range of chemical transformations. Considering the recent prize hikes of noble metals, this approach constitutes together with efficient metal recycling processes a key capability for future sustainable and competitive chemical production.

The second section of the program focused on sustainability linked to downstream processing as well as raw material sourcing. ***Dr. Julia Witte*** and ***Dr. Roman Goy*** from DSM unveiled a production scale application of an organic solvent nanofiltration (OSN) process for the removal of an impurity. A three-stage OSN process combined with a precipitation/filtration unit and challenging aspects of the process development, scale up and robustness were presented. In the succeeding contribution ***Dr. Jan C. van der Waal*** presented how TNO (the Netherlands Organization for Applied Scientific Research) is working to facilitate the energy and material transition towards de-fossilized, renewable and circular value chains. At the heart of these efforts is often

chemistry but also sound economical evaluations to assure that the right target compounds are tackled.

The first day was concluded with the keynote lecture by ***Prof. David MacMillan***, from Princeton University. Prof MacMillan, the Chemistry Nobel Prize winner of 2021, joined us *via* video call. Prof MacMillan presented the advent of organo-catalysis in his laboratory. Difficult to imagine a better illustration of how a discovery in the lab can have a big impact in industrial chemical production, and how work starting in the lab can touch our lives. Prof. MacMillan shared during his inspiring talk also many recent and exciting results linked to photocatalysis and beyond.

The second day started with the traditional SCS Sandmeyer Award lectures, illustrating successful and fruitful collaborations between companies/partners with complementary expertise and capabilities:

- Sandmeyer Award 2022 for the IBM research team, on 'Fueling the Digital Chemistry Revolution with Language Models'
- Sandmeyer Award 2023 for the Givaudan team, on 'Sustainable Production of (–)-Ambrox: Chemistry meets Bio-Catalysis'.

Following the Sandmeyer lectures, the second day was dedicated to presentations in the field of Sustainability and Process Optimization. The first contribution of this section was a tandem presentation by ***Dr. Alfred Stutz*** from Dottikon ES and ***Dr. Philipp Kohler*** from Idorsia describing the joint efforts for the process development and kilogram-scale production of a reaction involving an energetic bromo acetylene compound towards an anti-infective drug compound. The second presentation by ***Dr. Anaïs Jolit*** from DRT-Firmenich illustrated the biorefining process applied by DRT-Firmenich where Crude Sulfate Turpentine (CST), a byproduct of the Kraft process operated by the pulping industry, is processed to isolate alpha and beta pinene. Furthermore, diverse transformations of these renewable building blocks into a portfolio of perfumery ingredients as alternatives to petrochemical based routes have been displayed. The third talk by ***Dr. Antoine Klaue*** from Lonza took the audience into the field of process optimization and specifically into the re-design of the manufacturing of a multi-step process for a pharmaceutical compound. Reaction engineering as well as the redesign of the work up and product isolation process allowed to reduce the process mass intensity (PMI) by an impressive 60% without changing the reagents nor the synthetic route. In the last lecture of this symposium ***Dr. Jörg Sedelmeier*** from Roche reported on the application of a flow process to allow the processing of highly energetic, N-rich compounds which would not have been feasible in a standard batch reactor. The newly developed 7-step API process comprised in total an impressive four continuous flow reaction steps.

The lecture program was complemented by two short talks from Prominent Dosiertechnik AG, Regensdorf and Willy Bachofen AG (WAB), Muttenz. Prominent presented a new range of innovative pumps which are powered by linear motors allowing

Collage with symposium speakers and the organizers (Photos by David Spichiger (SCS), Franck Genilloud and Gabriel Demierre (HEIA-FR)).

to cover a very large flow range while maintaining a stable flow rate. WAB introduced an interesting extension of their wet milling technology as a continuous reactor. The presented systems consist of a bead mill reactor with an inductive heating allowing mechanochemical reactions in a continuous flow mode.

The poster session also saw a very good turnout with 21 posters comprising contributions from academia as well as industry. The posters covered a very wide range of subjects including continuous processing, catalysis as well as bio-catalysis, renewable raw material-based chemistry and analytical contributions. The two 'Best Poster Awards' went to:

– 'Single-atom catalysts applied in fine chemical synthesis' – ***Dario Poier et al.*** HEIA-FR

– 'A key perfumery ingredient from batch to continuous' – ***Fabio Casanova et al***. Firmenich

The two-day symposium touched on many relevant aspects for the future of the chemical industry in Switzerland and on elements helping to keep a competitive edge. It allowed also to illustrate what it takes to bring a great laboratory result to a commercial success. Moreover, the symposium provided a platform for fruitful discussions, exchange of ideas and networking, inspiring the participants to continue their work and commitment to advance the industrial chemistry in Switzerland and beyond for a more sustainable and innovative future.

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Exhibition and Poster Session during the lunch break (Photos by David Spichiger, SCS).