

Available online at www.sciencedirect.com

Food and Bioproducts Processing

journal homepage: www.elsevier.com/locate/fbp


Editorial

Fouling and cleaning in food processing in 2022

This virtual special issue (VSI) brings together papers based on work presented at the international conference on *Fouling and Cleaning in Food Processing* (FCFP 2022) held in Lille, France, in March 2022 and papers on the topic published in FBP in 2022. The removal of soil layers, whether fouling deposits generated during processing or residues of product remaining at product changeover, is a common and essential operation in many food, bioproduct and bioprocessing sectors. Removal requires time, energy and chemicals – including, in many cases, clean water – and therefore impacts the productivity, financial performance and environmental sustainability of the plant or manufacturing line. Selecting appropriate cleaning methods and optimising them requires an understanding of the processes and science involved: a very strong feature of the FCFP meetings has been the bringing together of engineers, physical scientists and microbiologists from industry and research institutes to discuss recent work and review developments in the field.

The Lille conference (to be precise, held in Villeneuve-d'Ascq, 28–30th March, 2022) followed that held in Lund in 2018, and was the 11th in the series that started in Lund in 1981. It was the first time that the conference has been held in France. During the conference, the 4 keynote talks, 36 oral presentations and a poster session promoted creative, stimulating exchanges of valuable knowledge and ideas between scientists, experts, industrialists and research students. The conference programme, the abstracts and presentations for which permission has been received can be viewed at <https://fcfp2022.symposium.inrae.fr/programme2>. This website will be active until the next FCFP event (FCFP 2025 –see below).

The conference was held as COVID-19 restrictions were starting to be lifted in some countries, so presentations were delivered in hybrid mode (in person and on-line). It was organized by UMET (Unité Matériaux et Transformations), a joint research unit spanning four establishments (CNRS, INRAE, Centrale Institute and the Université de Lille (UdL)) which hosts a large portion of the Materials Science research at UdL, and particularly by UMET's PIHM team (Processus aux Interfaces et Hygiène des Matériaux). The PIHM team have conducted scientific projects on food processing hygiene issues for INRAE (French National Research Institute for Agriculture, Food and Environment) since the early conferences (when it was known as INRA-LGPTA) and contributes to work on fouling & cleaning in food processes for the whole sector. The conference leads - Thierry Bénézech,

Christine Faille, Maude Jimenez and Guillaume Delaplace – were ably assisted by Aline Waquet (Communications officer) and Christophe Dufourmantelle (Financial Unit manager), who dealt with web and payment aspects, and by PIHM students, researchers and associates Marwan Abdallah, Thomas Danel, Heni Dallagi, Maureen Delplace, Yousra El Fannassi, Amelie Heliot, Anna Ipatova, Weiji Liu, Samah Mechmechani, Manon Saget, Angella Velazquez and Jina Yammine, who did much to make things happen (registration, session support and social events including a tour of Lille, gala dinners...). The organisers wish to thank the sponsors, namely the Fédération de Recherche Michel-Eugène Chevreul for the free use of their building, and financial support from Christophe Penverne, UdL and the MICA Division of INRAE who conduct fundamental and applied research in microbiology and biotechnology focused on food, animal and human health.

FBP has regularly featured special issues from these conferences over the years and a glance at the contents shows how work in the field has shifted from studying the generation of soil layers and fouling deposits on non-porous and membrane surfaces to understanding the mechanisms of cleaning and decontamination. This reflects the industrial need: in many cases, the formation of soiling layers and deposits is an unavoidable consequence of the materials and manufacturing process used. Sustainability gains and cost reduction lie in fouling prevention, cleverer cleaning, better sensors, and reduced resource consumption. Early studies presented the interaction between the factors involved in terms of Sinner's Cleaning Circle (Fig. 1(a)): this has evolved into the scheme in Fig. 1(b), which highlights the need to consider human as well as legislative constraints into design and operating decisions.

The VSI is introduced by an overview paper of modelling of cleaning and decontamination, which established the importance of these operations in virtually all sectors: it is hard to identify a sector where they are not important. The first set of papers consider fouling on solid surfaces – typically heat exchangers – including experimental investigations of how deposits form, and modelling studies to support design, operation and control. Manipulating solid surfaces at the microscale to mitigate fouling is the subject of two papers on biomimetic surfaces, followed by one considering the converse - the fouling of microstructured devices, which is important given the popularity of microfluidic devices. The food sector makes extensive use of membranes and the

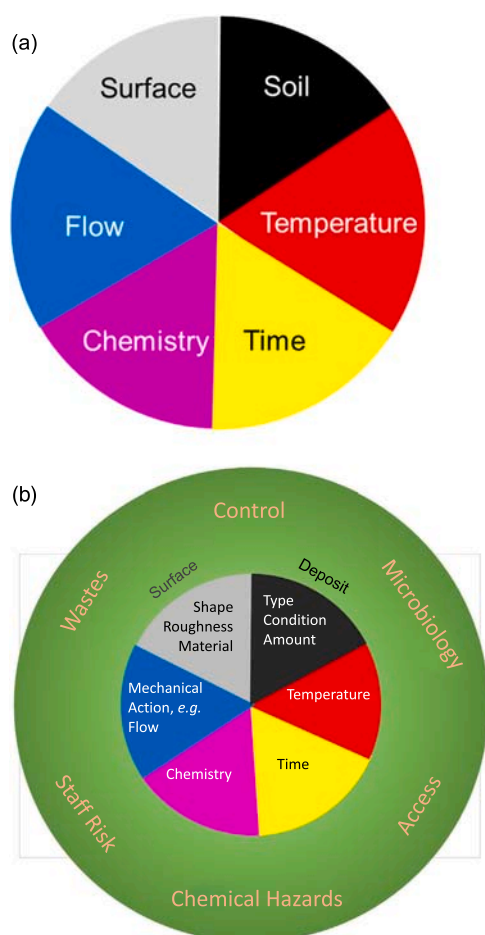


Fig. 1 – Evolution of Sinner’s cleaning circle from (a) the Extended form, after Wildbrett (2006) to the (b) System amongst Systems representation (reproduced from Wilson et al. (2022)).

concentration of rejected species at the surface promotes fouling in many cases, so three papers cover fouling and cleaning, with one looking at the emerging technology of microbubbles.

We have grouped the papers on cleaning into three topics. The first are experimental investigations of different cleaning methods, including novel flow patterns: interrupted and pulsed flows, and foams. The second set look at the science of cleaning, in several cases employing new methods to generate quantitative mechanistic insights into how cleaning happens. The third set combine detailed CFD simulations to predict cleaning performance in industrially relevant geometries. Cleaning imposes a dynamic mass transfer boundary condition on these calculations. Ultimately, cleaning science investigations will identify the form and parameters of such boundary conditions and allow devices to be designed for cleaning *in silico*. We look forward to seeing more work in this area to come.

The VSI contains fewer papers on microbiological aspects than earlier special issues. The conference programme at <https://fcfp2022.symposium.inrae.fr/> shows that there were 10 papers on these aspects at the meeting, reflecting its importance.

Plans are afoot for the next conference to be held in Dresden, Germany, from 25 to 27 March 2025. The FCFP 2025 meeting website is www.ivv.fraunhofer.de/fcfc2025

References

- Wildbrett, G. (2006) *Reinigung und Desinfektion in der Lebensmittelindustrie*, publ. Behr’s Verlag, Hamburg.
- Wilson, D.I., Christie, G., Fryer, P.J., Hall, I.M., Landel, J.R., Whitehead, K.A., 2022. Lessons to learn from roadmapping in cleaning and decontamination. *Food Bioprod. Proc.* 135, 156–164 [doi.org/10.1016/j.fbp.2022.07.011].

Thierry Bénézech, John Chew, Guillaume Delaplace, Christine Faille, Maude Jimenez, Ian Wilson
 Department of Chemical Engineering & Biotechnology, University of Cambridge, Philippa Fawcett Drive, Cambridge CB3 0AS, United Kingdom
 0960-3085/© 2022 Institution of Chemical Engineers.
 Published by Elsevier Ltd. All rights reserved.

<https://doi.org/10.1016/j.fbp.2022.12.003>

Available online 21 December 2022