CHEMICAL TRENDS TO KEEP AN EYE ON IN 2022-23

Abstract

Since its inception, the chemical industry has been characterised by its diversity and fragmentation. Basic chemicals, resins/synthetic rubber/fibers, petrochemicals, plastics/polymers, agriculture chemicals, medicines, biochemicals, coatings/adhesives, cleaning /toiletries, instrumentation/lab equipment, and many more are all included. There are products that have reached their full potential and others that still have a lot of room to develop. The clearance process for novel drugs also takes longer and costs more money as a result of tightening regulations. In addition, we currently exist in a time of flux, where numerous factors are impacting the chemistry industry. Sustainability research and development is a growing focus in the chemical industry. The chemical sector can make significant contributions to environmental protection through cutting-edge product development, manufacturing, distribution, consumption, and disposal. The 12 principles of green chemistry have the potential to improve chemical reactions and processes.

Keywords: Chemical Trends, Sustainability research, Principles of green chemistry, Global environment.

Author

Dr. Meenakshi Rathi
RNC Arts, JDB Commerce, NSC Science College, Nasik Road, City: Nasik
Postal Code: 422101
State: Maharashtra
Country: India
meenakship2@gmail.com

I. INTRODUCTION

We live in an ever-changing and tumultuous global environment. New possibilities are opening up as a result of the profound shifts in technology, science, and society that have occurred in the past few decades. Innovation will be easier to come by as chemistry moves toward greater interdisciplinary. (Bridle et al., 2013)(Bonney et al., 2009)(Lyall & Fletcher, 2013) The first step in mastering a new skill or knowledge, some of the most eminent members of the chemistry community had the following to say... "A broader definition of chemistry is required." There is a limit to how far you can go back in time with chemistry without it becoming like Latin in the scientific world. Chemists will find themselves in high demand in a variety of industries. Chemists will play an important role in the development of personalised medicine, mutational drugs, sequencing, vaccines for global health issues, and treatments related to the ageing population.(Hardy et al., 2020)(GUTTERIDGE & HALLIWELL, 2006)

In the year 2021, one word could sum up the field of chemistry: "growth." After a year of medical challenges and high demand from chemical and pharmaceutical research, 2021 saw big advances in technology and algorithm development to better understand and predict virus and illness effects. This growth pattern will continue in the chemistry industry (2022). Many new chemistry trends are expected to take off in 2022 (Weber et al., 2022) and beyond, from improving chemical production sustainability by using technology to fight the COVID-19 pandemic.(Mishra et al., 2021)

As we look ahead to 2018, we have picked out four things to keep an eye on. To get a better sense of the current state of science and to be inspired by new developments that are expected to improve our well-being in the coming year and beyond.

1. **Production of chemicals in an environmentally friendly manner:** There will be an increased focus on sustainability in the chemistry industry in the coming years, as governments and organisations around the world are being pressed harder than ever to focus their efforts on sustainable living and production.(Middlecamp, 2019)(Wissinger et al., 2021)

   Decarbonisation of production processes will be a major focus for many chemical companies in future years. (Rajabloo et al., 2022) They will begin by conducting research into ways to reduce the amount of carbon produced by their business practises and chemical manufacturing. (Oberthür et al., 2021)An increase in investment in recycling technologies, as well as an effort to reduce emissions and plastic waste that occur in the course of business, is expected.

   This is not the only area where companies will be looking for ways to improve their environmental footprints. As a result, many businesses are examining how they can work together to reduce their combined environmental impact and how they can assist customers in doing the same. This means that you can expect to see more chemical companies and key players in the industry working to reduce their waste and emissions by 2023.(Ng et al., 2021)

2. **Prediction of virus outbreaks using artificial intelligence:** It is understandable that much of the industry's attention will be focused on improving our understanding of the COVID-19 pandemic and other viruses. Vaccine research and effective treatment for those who are clinically vulnerable or in the hospital requiring treatment will both see a lot of investigation.

   Sharing genomes from laboratories at the forefront of viral infection with researchers worldwide was a first step in the scientific community's response to the outbreak of the COVID-19 pathogen.

   DeepMind, the company behind Google's impressive AI, announced that AI could solve the protein folding problem in 2020. Can amino acid sequence predict protein structure? They help us understand cellular activities and reactions. DeepMind predicted the structures of two SARS-CoV-2 proteins after studying the Coronavirus. This spurred growth. DeepMind's work, which culminated decades of research into that virus family, led to a therapeutics platform.

   The chemistry of the substance will be closely examined. For example, will it be able to predict the locations of drug-binding pockets? Is not it possible to increase the efficiency and effectiveness of drug development? Could protein folding be predicted ahead of time? If it succeeds, what are the ramifications for humanity?

3. **The efficiency of individualised drug treatments has increased:** Some of the most common pharmaceuticals on the market are made using the "chaining" process. It is through this technique that scientists are creating a wide range of chemical structures that could one day serve as the basis for pharmaceuticals.A wide range of medications, including those used to treat physical and mental health conditions such as chronic pain and leukaemia, are based on this process.

   Because each of these illnesses and conditions is so unique, some require a re-calibration of the nervous system's chemical balance, while others must be transported throughout the bloodstream to affect cells all over the body as a whole via the circulatory system. Consequently, each medication that we use to treat and manage these conditions must undergo a unique creation process. As a result, a lengthy and often expensive process of medicinal chemistry is required to make rings with different configurations for different illnesses.

   Chemists in the year 2022 will be focused on finding ways to accelerate the development of medications for a wide range of illnesses by simplifying and streamlining the process. New research is already generating hypotheses about how the procedure might be improved.

   With the help of oxidation of two carbon-hydrogen bonds, scientists have discovered a way to selectively add, remove, or alter hydrogen molecules in a chain. The process addresses some issues with early-stage drug development, but it is prohibitively expensive and difficult to scale up. Also, research is just getting started, so more work must be done to see if we can streamline the process in the future. As a result, do not be surprised if work in this area continues well into the coming few years.

4. **Weaponized sensors will enhance healthcare surveillance:** This holiday season, smartwatches will be at the top of many people's wish lists, but not for the reasons you might expect. Today's high-tech world makes it all too easy for us to adopt sedentary habits;

   - Automated systems that turn on the light bulbs and TVs for us without us having to do anything are a common sight in our homes or classrooms.
   - New technologies, on the other hand, are encouraging us to make small improvements in our health and well-being.
   - It used to be that companies like Fitbit and Apple focused on fitness enthusiasts, but now they are expanding into the scientific community. Wearable technologies are paving the way for the collection of health-related data that will improve millions of lives. We track heartbeats, glucose levels, and viral infections. Smartwatches are becoming increasingly popular because they allow us to access telemedicine, physical therapy, and even medication reminders, all from the convenience of our wrists.
   - To combat pandemics and other viral illnesses, we have already seen how these wearable devices have been programmed with new algorithms in 2021 to detect emerging illnesses, like COVID-19. So we are eager to see how these technologies can be improved even further in 2022 to increase the efficiency of chemists and healthcare.
   - Your basic vitals and other information can currently be taken by doctors and shared with wider teams to gain valuable insight into your health so that changes can be made and medications prescribed that could improve your overall well-being.Besides this, smartwatch apps, such as those for diabetes management, can help you improve your overall well-being.
   - In 2022, app developers are expected to spend more money creating new resources to help millions of people live better lives. These resources will be developed in collaboration with scientists and other healthcare professionals.

5. **IUPAC's Top Ten Emerging Technologies in Chemistry project:** IUPAC's Top Ten Emerging Technologies in Chemistry project aims to demonstrate the value of chemistry and educate the public on how the chemical sciences contribute to society's well-being and Earth's sustainability. (Gomollón-Bel, 2020) Since 2019, the Jury has chosen emerging technologies based on their potential to open up new opportunities in chemistry and beyond.(https://iupac.org/)

Year	2019	2020	2021
IUPACS EMERGING TRENDS	Nanopesticides	Emissions caused by a buildup of waste	Blockchain technology
	Organocatalysis with Enantioselective Control	A chemistry-based application of artificial intelligence	Chemiluminescence for biological use
	Batteries made of solid state	Batteries with dual ion cells	Chemical synthesis of RNA and DNA
	Chemical Flow	Inorganic chemistry under high pressure.	Semi-synthetic life
	Extrusion in Reaction	the use of liquid gating systems	Single cell metabolomics
	Inorganic frameworks made of metal (MFOs)	For improved plastic recycling, use of macromonomers	Sonochemical coatings
	Evolving Enzymes for Specific Purposes	Contaminants in the microbiome that have biological effects	Super wettability
	Creating Monomers from Plastics	Nanosensors	Long-term ammonia production, and
	Reversible. Radical Polymerization Deactivation	For testing, quick diagnostics	selective protein degradation
	3D-Bioprinting	For testing, quick diagnostics	Blockchain technology
	Nanoemulsions	RNA vaccines are currently in development.	Chemiluminescence for biological use

II. CONCLUSION

In the future of the chemical sciences, technological advancements and the rapid adoption of innovation will have a significant impact. As chemistry research, organisational structures, and career options evolve, so too will the field itself. Increasingly sophisticated computer modelling and metrology will be made possible by technological advancements. This is likely to increase the need for cross-disciplinary work and alter research methods, academic and professional career paths, organisational structures, and industrial structures. As an example, there may be more start-ups, specialists, and niche players. It is expected that experimentation will become much more efficient in the future. This will have an effect on research, as well as on who is able to do it and on the infrastructure required. It is possible to drastically reduce the amount of time it takes to model and "get stuff out of the lab" through advances in computational technology and real-time and high-throughput experimentation. We expect to see some changes in the methods used to conduct organic synthesis research, in addition to more attention being paid to general catalytic chemistry and testing the physical properties of model compounds. It is possible that "molecules on demand" production will follow, but that is a development that is at least ten to twenty years away. It is possible that chemists can create models on-demand for specific clients and develop a product without conducting extensive testing. An increasingly diverse group of people will be able to identify problems and participate remotely in experiments to develop solutions as a result of new technological developments.

REFERENSES

[1] Bonney, R., Cooper, C. B., Dickinson, J., Kelling, S., Phillips, T., Rosenberg, K. V., & Shirk, J. (2009). Citizen science: A developing tool for expanding science knowledge and scientific literacy. *BioScience*, *59*(11), 977–984. https://doi.org/10.1525/BIO.2009.59.11.9

[2] Bridle, H., Vrieling, A., Cardillo, M., Araya, Y., & Hinojosa, L. (2013). Preparing for an interdisciplinary future: A perspective from early-career researchers. *Futures*, *53*, 22–32. https://doi.org/10.1016/J.FUTURES.2013.09.003

[3] Gomollón-Bel, F. (2020). Ten Chemical Innovations That Will Change Our World. *Chemistry International*, *42*(4), 3–9. https://doi.org/10.1515/ci-2020-0402

[4] GUTTERIDGE, J. M. C., & HALLIWELL, B. (2006). Free Radicals and Antioxidants in the Year 2000: A Historical Look to the Future. *Annals of the New York Academy of Sciences*, *899*(1), 136–147. https://doi.org/10.1111/j.1749-6632.2000.tb06182.x

[5] Hardy, M. A., Wright, B. A., Bachman, J. L., Boit, T. B., Haley, H. M. S., Knapp, R. R., Lusi, R. F., Okada, T., Tona, V., Garg, N. K., & Sarpong, R. (2020). Treating a Global Health Crisis with a Dose of Synthetic Chemistry. *ACS Central Science*, *6*(7), 1017–1030. https://doi.org/10.1021/acscentsci.0c00637

[6] Lyall, C., & Fletcher, I. (2013). Experiments in interdisciplinary capacity-building: The successes and challenges of large-scale interdisciplinary investments. *Science and Public Policy*, *40*(1), 1–7. https://doi.org/10.1093/SCIPOL/SCS113

[7] Middlecamp, C. H. (2019). Sustainability in the Chemistry Curriculum: A Call for Action. *Israel Journal of Chemistry*, *59*(6–7), 504–513. https://doi.org/10.1002/ijch.201800069

[8] Mishra, A., Choudhary, M., Das, T. R., Saren, P., Bhattacherjee, P., Thakur, N., Tripathi, S. K., Upadhaya, S., Kim, H. S., Murugan, N. A., Tiwari, A., Patra, S., Hussain, C. M., Mishra, A., Shukla, S. K., & Joshi, G. M. (2021). Sustainable chemical preventive models in COVID-19: Understanding, innovation, adaptations, and impact. *Journal of the Indian Chemical Society*, *98*(10), 100164. https://doi.org/10.1016/J.JICS.2021.100164

[9] Ng, C., Cousins, I. T., DeWitt, J. C., Glüge, J., Goldenman, G., Herzke, D., Lohmann, R., Miller, M., Patton, S., Scheringer, M., Trier, X., & Wang, Z. (2021). Addressing Urgent Questions for PFAS in the 21st Century. *Environmental Science & Technology*, acs.est.1c03386. https://doi.org/10.1021/acs.est.1c03386

[10] Oberthür, S., Khandekar, G., & Wyns, T. (2021). Global governance for the decarbonization of energy-intensive industries: Great potential underexploited. *Earth System Governance*, *8*, 100072. https://doi.org/10.1016/j.esg.2020.100072

[11] Rajabloo, T., De Ceuninck, W., Van Wortswinkel, L., Rezakazemi, M., & Aminabhavi, T. (2022). Environmental management of industrial decarbonization with focus on chemical sectors: A review. *Journal of Environmental Management*, *302*, 114055. https://doi.org/10.1016/j.jenvman.2021.114055

[12] Weber, L., Ebeler, F., & Ghadwal, R. S. (2022). Advances and recent trends in dipnictenes chemistry. *Coordination Chemistry Reviews*, *461*, 214499. https://doi.org/10.1016/J.CCR.2022.214499

[13] Wissinger, J. E., Visa, A., Saha, B. B., Matlin, S. A., Mahaffy, P. G., Kümmerer, K., & Cornell, S. (2021). Integrating Sustainability into Learning in Chemistry. *Journal of Chemical Education*, *98*(4), 1061–1063. https://doi.org/10.1021/acs.jchemed.1c00284

[14] Bonney, R., Cooper, C. B., Dickinson, J., Kelling, S., Phillips, T., Rosenberg, K. V., & Shirk, J. (2009). Citizen science: A developing tool for expanding science knowledge and scientific literacy. *BioScience*, *59*(11), 977–984. https://doi.org/10.1525/BIO.2009.59.11.9

[15] Bridle, H., Vrieling, A., Cardillo, M., Araya, Y., & Hinojosa, L. (2013). Preparing for an interdisciplinary future: A perspective from early-career researchers. *Futures*, *53*, 22–32.

https://doi.org/10.1016/J.FUTURES.2013.09.003

[16] Gomollón-Bel, F. (2020). Ten Chemical Innovations That Will Change Our World. *Chemistry International*, *42*(4), 3–9. https://doi.org/10.1515/ci-2020-0402

[17] GUTTERIDGE, J. M. C., & HALLIWELL, B. (2006). Free Radicals and Antioxidants in the Year 2000: A Historical Look to the Future. *Annals of the New York Academy of Sciences*, *899*(1), 136–147. https://doi.org/10.1111/j.1749-6632.2000.tb06182.x

[18] Hardy, M. A., Wright, B. A., Bachman, J. L., Boit, T. B., Haley, H. M. S., Knapp, R. R., Lusi, R. F., Okada, T., Tona, V., Garg, N. K., & Sarpong, R. (2020). Treating a Global Health Crisis with a Dose of Synthetic Chemistry. *ACS Central Science*, *6*(7), 1017–1030. https://doi.org/10.1021/acscentsci.0c00637

[19] Lyall, C., & Fletcher, I. (2013). Experiments in interdisciplinary capacity-building: The successes and challenges of large-scale interdisciplinary investments. *Science and Public Policy*, *40*(1), 1–7. https://doi.org/10.1093/SCIPOL/SCS113

[20] Middlecamp, C. H. (2019). Sustainability in the Chemistry Curriculum: A Call for Action. *Israel Journal of Chemistry*, *59*(6–7), 504–513. https://doi.org/10.1002/ijch.201800069

[21] Mishra, A., Choudhary, M., Das, T. R., Saren, P., Bhattacherjee, P., Thakur, N., Tripathi, S. K., Upadhaya, S., Kim, H. S., Murugan, N. A., Tiwari, A., Patra, S., Hussain, C. M., Mishra, A., Shukla, S. K., & Joshi, G. M. (2021). Sustainable chemical preventive models in COVID-19: Understanding, innovation, adaptations, and impact. *Journal of the Indian Chemical Society*, *98*(10), 100164. https://doi.org/10.1016/J.JICS.2021.100164

[22] Ng, C., Cousins, I. T., DeWitt, J. C., Glüge, J., Goldenman, G., Herzke, D., Lohmann, R., Miller, M., Patton, S., Scheringer, M., Trier, X., & Wang, Z. (2021). Addressing Urgent Questions for PFAS in the 21st Century. *Environmental Science & Technology*, acs.est.1c03386. https://doi.org/10.1021/acs.est.1c03386

[23] Oberthür, S., Khandekar, G., & Wyns, T. (2021). Global governance for the decarbonization of energy-intensive industries: Great potential underexploited. *Earth System Governance*, *8*, 100072. https://doi.org/10.1016/j.esg.2020.100072

[24] Rajabloo, T., De Ceuninck, W., Van Wortswinkel, L., Rezakazemi, M., & Aminabhavi, T. (2022). Environmental management of industrial decarbonization with focus on chemical sectors: A review. *Journal of Environmental Management*, *302*, 114055. https://doi.org/10.1016/j.jenvman.2021.114055

[25] Weber, L., Ebeler, F., & Ghadwal, R. S. (2022). Advances and recent trends in dipnictenes chemistry. *Coordination Chemistry Reviews*, *461*, 214499. https://doi.org/10.1016/J.CCR.2022.214499

[26] Wissinger, J. E., Visa, A., Saha, B. B., Matlin, S. A., Mahaffy, P. G., Kümmerer, K., & Cornell, S. (2021). Integrating Sustainability into Learning in Chemistry. *Journal of Chemical Education*, *98*(4), 1061–1063. https://doi.org/10.1021/acs.jchemed.1c00284