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Challenges in the Surfactants Industry and the Path Forward for New Solutions in a Variety of Applications

Surfactants are used in a wide spectrum of applications from detergents to cosmetics to crop protection to oil & gas — and many more in between. This broad range will be the focus of the 12th World Surfactants Congress to be held in Rome in early June 2023. The congress will broach the challenges in the surfactants industry that needs to transform its operating model to become more sustainable and contribute to the EU Green Deal objectives. Tony Gough, President of CESIO, the European Committee of Organic Surfactants and their Intermediates, and Director of Innovation for Sustainability at Innospec, provides a status report on the surfactants business, market, and technology.

CHEManager: CESIO organizes the World Surfactant Congress only once every four years. That means, a lot has happened in and around the industry since the previous Congress in 2019. How did the industry do during the Covid pandemic with its supply chain

disruptions and lockdowns? The global Covid outbreak being hardly over, Russia started a war in Europe with dramatic consequences for the market and business conditions. How is this ongoing conflict in the Ukraine affecting the surfactants industry?

Tony Gough: Since early 2020, just nine months after our previous CESIO Congress, Covid-19 came upon us and triggered lockdowns all over the world with huge impacts on supply chains and industrial manufacturing; not to mention the mental and physical stress exerted on individuals across the globe. Then in early 2022, when the world had made good progress in being able to get the virus under control, Russia started the war in the Ukraine which caused a great hike in inflation due to reduction in Russian gas and oil supply. This resulted in a dramatic increase in prices of surfactant and chemical feedstocks, which now seem to be stabilizing in most areas, with prices of some feedstocks even starting to come down, although still being generally higher than in pre-Covid times.

A side effect of the pandemic on the surfactants industry was a massive demand for sanitizers, cleansing, and household cleaning products. However, other sectors and industries weren't so



Tony Gough, President, CESIO

fortunate. The lockdowns had a huge adverse impact on institutional cleaning in the hotel, restaurant, and tourism sectors. Also, consumer buying habits have been affected by increasing numbers of purchases being made online, causing retail sales to decline.

On top of all of that, there have been major issues with shipping, availability of bulk-containers, availabilities of feedstocks in the far east, shortages of trucks and truck drivers in Europe particularly, and severe hikes in costs for transporting goods in all regions of the world, which also caused problems with surfactant and feedstock supply chains, but the situation now seems to be gradually improving.

Recovery from all of these setbacks is showing that our industry has a great degree of resilience and is able to absorb external shocks like Covid-19. Surfactants are manufactured from a plethora of feedstocks and are enablers for many downstream applications. It is this versatility and diversity that keeps the surfactant industry alive. We hope that the world has some good learnings from Covid-19 and now knows what steps to take and which not to take in the unlikely event that another global pandemic occurs within our lifetimes.

The climate crisis has even bigger potential to transform the industry than the war and the pandemic.





That is saying something ...! Does the agenda of CESIO 2023 reflect the importance of the global fight against climate change?

T. Gough: Whilst it is debatable in some quarters that the world has reached the stage of being in a climate crisis, there is a need to reduce man-made emissions of carbon dioxide—CO₂—to limit global warming to just a 1.5°C rise and REACH net zero in global CO₂ emissions by 2050 according to the Paris Agreement. Confounding this is the fact that it is estimated that the demand for carbon-based chemicals globally will more than double by 2050. If the demand is not to be satisfied by fossil-based feedstocks, renewable carbon production will need to increase by 15x to phase out the use of fossil carbon in consumer products. Big challenges are therefore set for the chemical and surfactants industry to take action and reduce their reliance on fossil fuels-based energy and feedstocks.

The program for the upcoming Congress lists one keynote from a high-level speaker from the EU Commission, ten plenary speakers, almost 60 session speakers, numerous posters and a panel discussion as the last session of the event. Many of the speakers will focus on 'sustainable

surfactants' such as bio-based surfactants, the future of palm oil in Europe, biomass as a basis for surfactant design, clean future for consumer goods, sustainable cleaning and the transformation of the home and personal care industry, and so on. Many will also demonstrate how the green deal and the EU chemical strategy for sustainability will affect our industry, for example, the expected notification and registration of polymers under REACH, the so-called Safe-and-Sustainable-by-Design strategy or the mixture assessment factor within the REACH-review. Participants will have a colorful picture of challenges provoked by the fight against climate change and opportunities for our industry.

The green transformation has been on the CESIO agenda for more than 20 years already but obviously picked up pace in recent years. What are the major strategies of surfactant manufacturers to reduce their carbon footprints and become carbon neutral?

T. Gough: As has been mentioned above, the chemical and surfactants industry needs to take action to reduce its reliance on fossil fuels for both energy and raw materials.

Many surfactant manufacturers have programs in place to address this by analyzing their types of carbon emissions associated with their products through Life Cycle Assessments —LCAs—, Product Carbon

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Footprints —PCFs and Product Environmental Footprints—PEFs. These will help them to identify ways to improve their processes to use less energy (for example better catalysts), and use more sustainable feedstocks which are bio-based, from circular sources or from carbon capture and utilization. Surfactants manufacturers are also increasingly looking at using their products to develop novel example guide formulations for their customers which are more sustainable than conventional product types. Examples of these are solid or concen-

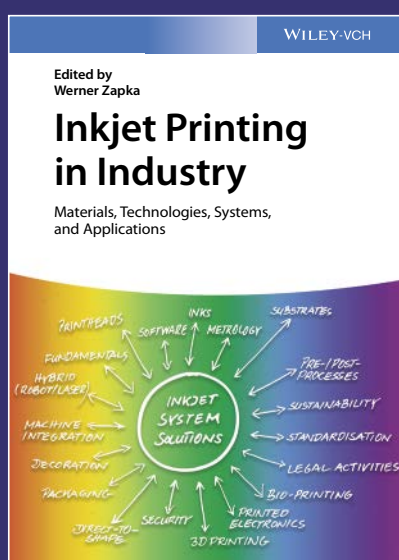
trated cleansing formats for personal care, home care and I&I. Manufacturers of surfactants used in laundry detergents are also looking at ways to make example guide formulations which are effective for low temperature washing, as most of the CO₂ emissions associated with current laundry detergents arise from heating the water used in the washing process.

Until the end of the last century, surfactants were mainly fossil-based and biobased surfactants were exotic foreigners. How has the feedstock base of surfactants changed in the past decades?

T. Gough: While there are surfactants on the market that are 100% naturally derived, and some that are 100% fossil-based, many surfactants are hybrids.

At present, some 50% of surfactants in Europe already have at least one constituent from a renewable feedstock. The choice of the feedstock will depend upon the type of application, properties required, availability, its sustainability, and also its cost. With regards to the use of palm kernel oil, this feedstock has become very attractive over the last 25 years

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due to the aftermath of the mad cow disease at the end of the 1990's which led to a decreased use of tallow as feedstock. There is also the recent emergence of biosurfactants such as the glycolipids, sophorolipids, and rhamnolipids which are now available on industrial scale. Manufacturers of these biosurfactants have established their factories in areas where they can locally source these feedstocks. Another example of a new feedstock for surfactants is bionaphtha obtained by various means from plant derived materials. This can be 'cracked' as per conventional naphtha to give feedstocks like ethylene. However, these types of feedstocks are often available solely as a 'mass balance' approach since global supply is too low to allow 100% fossil free material to be made and it would currently be prohibitively expensive.

However, we know that just because a material is either naturally derived from fermentation or renewables does not always mean that it is 'more sustainable' or has a better safety profile. It is the chemistry behind them, the energy used, the eco-footprint and the way the feedstocks have been manufactured and transported which determines the sustainability and safety profile. Ultimately, our interest is in open and competitive access to any feedstocks which meet customer needs, and in their contributions to more sustainable products and processes.

The EU Chemical Strategy for Sustainability is part of the EU's zero pollution ambition—a key commitment of the European Green Deal. Its implementation will have far-REACHing consequences for the chemical industry and the users of chemical products. How does CESIO evaluate the measures and rules proposed by the CSS?

T. Gough: CESIO has been monitoring and contributing to policy development initiatives to realize the objectives of the EU Chemical Strategy for Sustainability—CSS—and wants to play a constructive role in its implementation. We believe a holistic approach is needed that incentivizes innovation and improved sustainability in Europe, whilst also recognizing the relevance of existing legislation for REACHing sustainability targets. It is especially important for us to help to ensure that companies operating within Europe are never put at a competitive disadvantage as they strive to meet important sustainabil-

ity targets compared to companies operating outside Europe.

CESIO has researched and expanded knowledge on polymeric surfactants, including biodegradability and future registration requirements. They've worked with AISE in the ERASM initiative for over 30 years to assess surfactant risks. A lot of tests and data, such as developed by the HERA Project or for REACH, are widely available or can be accessed on the OECD Existing Chemicals Database.

Sustainability is not an inherent property of a substance. Surfactants often show their positive effects mainly in the end use. Is it the right way to go for a primarily hazard-based approach that provides for a general ban of certain substances?

T. Gough: Whether or not a weapon is good or bad depends on how it is used. We can use this analogy for chemicals: whether or not a chemical is harmful to living things or the environment can only be determined by the hazard, the exposure from use and the risk resulting from the combination of the two. A chemical may be toxic to fish or daphnia—that is, it is hazardous—but this is irrelevant if this chemical will never be released into aquatic environments. Furthermore, if a chemical is banned or restricted solely on the basis of its hazard, this will lead to overregulation. In addition, substances could be withdrawn from the markets which even have a positive impact on sustainability!

This is why we have a huge concern with regards to the so-called generic risk approach favored by the EU regulators, which would restrict larger groups of chemicals due to specific properties, such as their persistency. This approach is nothing more than restriction based on the hazard profile, and, in many cases based on just a single hazard property. 'Generic' in this context means: should not be present in a consumer product or end up in the environment as a 'forever chemical', even though there is no evidence or proof of a specific risk. This approach is ill-considered and would not be good for the invaluable contribution the chemical industry makes to the world economy or humankind in general.

Do you think that more or tighter chemicals legislation and regula-

tion will propel the development of more sustainable products? What is CESIO's approach to sustainable development?

T. Gough: Many legislative changes are currently taking place in Europe, which should help to REACH CSS targets. This includes the revisions of the European chemical and labelling regulations—REACH and CLP—, the EU Ecodesign legislation, initiatives to support Safe & Sustainable by Design products, among many other initiatives linked to water and GHG emissions. In addition, other updates to existing vertical legislation, such as to the Detergents Regulation and to existing EU ecolabel criteria are planned.

As noted earlier, it is important to ensure that any new legislation constructively contributes holistically to improving sustainability whilst supporting innovation. To achieve this, any new rules should be fit for purpose and not duplicate or overlap with existing frameworks. CESIO will continue to play its part both in on-going research projects and contributing to the development and implementation of any new legislation.

Apart from sustainability, what drives the development of new surfactants? What are the hot trends in finished product R&D these days?

T. Gough: The obvious answer to this is that a new surfactant must address an identified unmet market need. It must also possess all the usual expected properties such as biodegradability, low toxicity and be cost effective. However, it is a rare occurrence for a new surfactant to be launched onto the market. Biosurfactants such as sophorolipids and rhamnolipids are relative newcomers being geared up for large industrial scale production and are being positioned mainly for their sustainability. We expect that mainstream surfactants will continue to be mainstays of the surfactants industry and be in major demand globally for many years to come. They will also undoubtedly be subjected to sustainability scrutiny in attempt to improve their LCAs.

Product developers, manufacturers and consumers are all seeking more and more sustainability aspects associated with personal care and home care products. This goes for both the contents and the packaging that are used for the products. This has led to the recent emergence of more solid-format and con-

centrated-format products on the market which use no water, or reduced water content in their manufacturing less packaging than conventional products. We therefore require surfactants which are capable of being used in these formats. Examples are solid shampoos which can be in powder form or bar form, concentrated shampoos which contain less water than conventional shampoos, and various novel solid or concentrated formats for laundry detergents.

Another trend is for formulators to seek surfactants which have some kind of eco-organisation certification. Examples of this are Ecocert Cosmos and Ecocert Detergent, Natrue, etc. There are currently relatively few surfactant types which meet the criteria of these agencies, but the list is expected to grow as more surfactants emerge that are either synthetic but are 100% naturally derived or are biosurfactants.

Yet another trend with continuing growth is sulfate free cleansers in the personal care sector. Surfactants with continuing growth in this category include isethionates, taurates, alpha-olefin sulfonates, glutamates and betaines, to name a few.

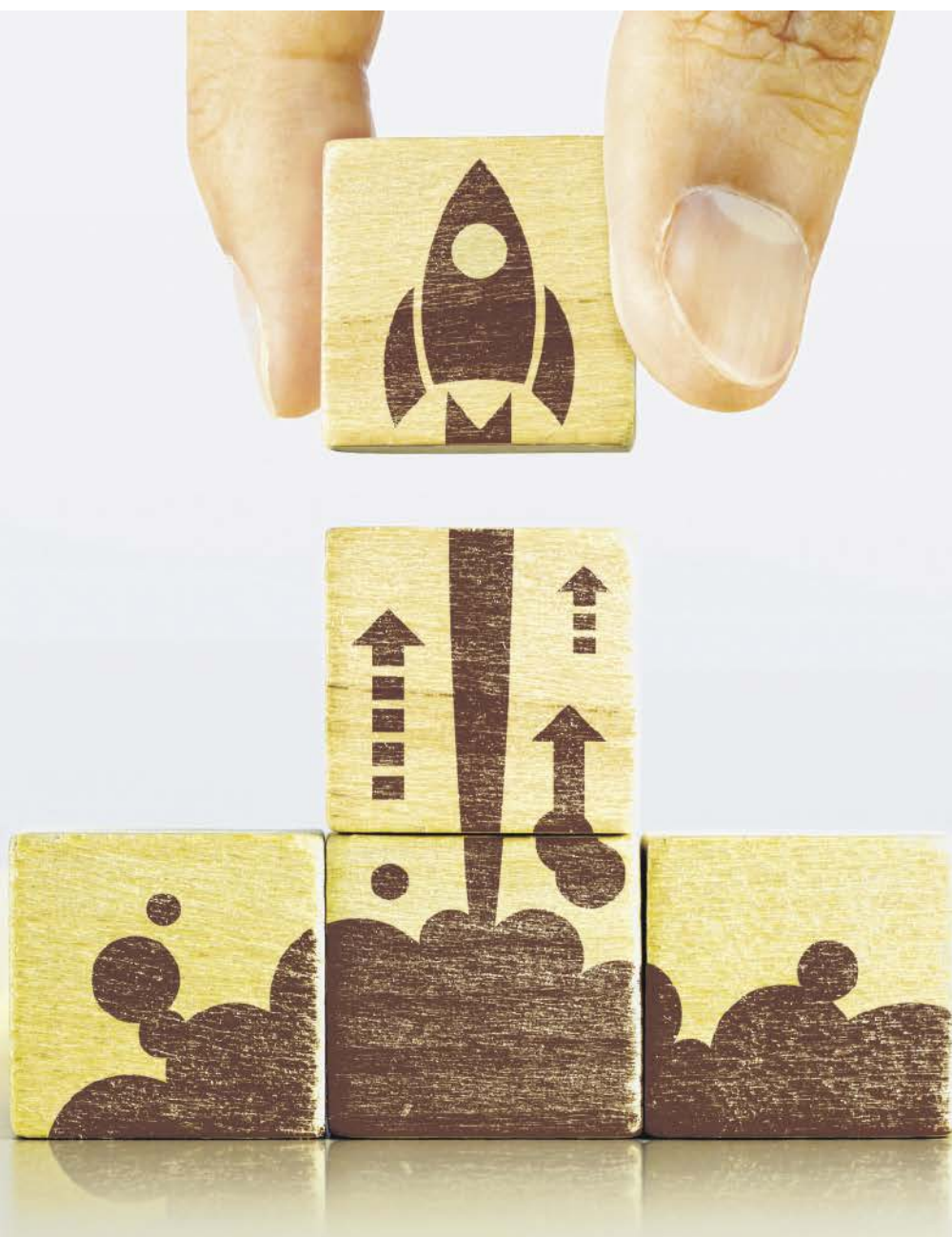
Pre-Covid, the overall market situation for surfactants in Europe was pretty stable. Given the current uncertain market and business conditions, can you provide an outlook on the market development for surfactants and the growth expectations in the years to come?

T. Gough: The outlook for surfactants is extremely healthy. Demand for most, if not all current surfactant types, is expected to grow, not just in Europe but globally. Also, surfactants with increasing levels of sustainability, including those which are fossil free, are expected to increase in demand. Fossil free surfactants will have two categories; those synthesized from fossil free feedstocks and those made through biotechnology routes. The future—therefore—looks bright for the surfactants industry!

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