

Advanced Oxidation Treatment for Wastewater

Oxidative Destruction of Organic Micropollutants with Nanoporous Catalysts and Scalable Energy Sources

Wastewater generated from industrial production streams and contaminated groundwater contains a massive range of micropollutants, like pharmaceuticals, pesticides, and industrial chemicals such as PFAS. These persistent compounds are non-biodegradable, bio-active, carcinogenic, and toxic to the lives of humans and our ecosystems. The Schlieren, Switzerland-based start-up Oxyle has developed a unique technology that offers complete removal and real-time monitoring of a wide range of micropollutants in a cost-effective and sustainable manner. Oxyle's co-founders, CEO Fajer Mushtaq and CTO Silvan Staufert, explained to CHEManager their unique overall approach to solve the global water contamination crisis and the company's next steps.



Fajer Mushtaq, Oxyle



Silvan Staufert, Oxyle

CHEManager: What was the starting point and motivation for founding Oxyle?

Silvan Staufert: Coming from a highly competitive and innovative University, ETH Zurich, we've realized the lack of innovation or sense of urgency by the water sector to address the emerging threat of organic pollutants in our water resources. By focusing our research into this area, we were able to achieve a technological breakthrough that can address the varied customer needs in this growing and profitable market. We were motivated to find Oxyle to be global leaders in protecting our precious water resources against micropollutants.

What is unique about your approach to solving the global water contamination crisis?

Fajer Mushtaq: We have developed a market-disruptive technology platform comprised of our modular plug-and-play reactors, our unique nanoporous catalysts, and our real-time water quality monitoring services. Our catalyst is activated by scalable energy sources such as bubbling, mechanical vibrations, stress, or even the flow of the water itself. Once activated by these clean and sustainable energy sources, our catalyst starts generating highly reactive radicals

that destroy a wide range of micropollutants and degrade them into mineralised by-products such as water, sulphates, chloride, etc. Our solution is applicable to treat a wide array of micropollutants from industrial chemicals like PFAS to pesticides or pharmaceuticals, in a wide concentration range—from low ng/L to 100's of mg/L.

What are the value propositions Oxyle offers its customers?

S. Staufert: We offer our customers an efficient water treatment and monitoring platform that can treat all micropollutants of concern, non-selectively. Our treatment technology is driven by clean energy sources, does not use any toxic chemicals, and does not produce any secondary waste. We allow our customers to reuse treated water and reduce their blue water consumption and improve their sustainability goals. Our real-time micropollutant monitoring technology ensures that only the highest quality effluents are discharged. By working with our environmentally friendly solution, our customers enjoy a sustainable image. Our solutions are 2 – 10x cheaper than the existing solutions on the market. Moreover, our fully automated, easy-to-use modular technology ensures that our customers meet even the most stringent regulations.

What have been the most exciting projects so far?

F. Mushtaq: With our technology, we eliminate even the most mobile and persistent micropollutants such as Forever Chemicals, commonly referred to as PFAS chemicals (over 8,000 chemicals). Due to their highly persistent and stable form, if these toxic and carcinogenic chemicals are not effectively treated, they contaminate our precious ecosystems. One of the most exciting and impactful projects that we recently completed was focused on the removal of a range of these PFAS chemicals from contaminated groundwater. With our treatment, we demonstrated the removal of all measured PFAS compounds to below detection limits, in a sustainable, scalable, and cost-effective manner for our customers. Highly rewarding outcome considering there are thousands of such sites all over Europe. With our effective treatments, Oxyle will not only improve the health of our contaminated ecosystems but also protect humans from their negative impact.

What are your next steps in technology and business development?

F. Mushtaq: At present, we are piloting our technology at various customer sites across Europe to gain

PERSONAL PROFILES

Fajer Mushtaq, CEO and co-founder, has a master's in mechanical engineering and a PhD from ETH Zurich in developing novel nanomaterials for water remediation. Having grown up in India with limited access to water resources, Fajer is determined to introduce effective and affordable water solutions on the market.

Silvan Staufert, CTO, and co-founder has a master's in mechanical engineering and a PhD from ETH Zurich on developing new sensors for micro and nano applications. Coming from a family of engineers, Silvan has always been passionate about using his engineering skills for bringing a long-lasting impact on the health of our ecosystems.

valuable customer testimonials and grow our outreach into new segments. We are also increasing our production capability to scale our operations and developing our remote monitoring service packages. We will bring our full-scale reactors to market towards the end of this year to serve our industrial customers and water remediation companies.



BUSINESS IDEA

Nanotechnology-Driven Wastewater Treatment

At present, 80% of the world's wastewater is discharged into rivers, lakes, and groundwater bodies without receiving any treatment. Rapid industrialization and growing demand for better consumer goods mean ever-increasing discharge of toxic pollutants into effluents and a strain on our freshwater resources. Just this year, EPA's health advisory level for PFOA (a chemical used in the production of waterproof clothes, Teflon, cosmetics, etc.) was drastically lowered from 400 ppt (ng/L) in 2009 to 0.004 ppq (pg/L), due to the danger these chemicals pose to humans when consumed.

Removal of Micropollutants

Oxyle has developed a sustainable and scalable technology that destroys a wide range of micropollutants including the forever chemicals such as PFAS, pharmaceuticals, hormones, pesticides etc. from contaminated wastewater. Oxyle's novel treatment process is driven by their nanoporous catalysts that oxidize and eliminate micropollutants, down to detection limits of 1 ng/L, even for the highly persistent compounds

that are resistant to existing treatments—a value that is 10–100x lower than our competitors.

Real-Time Monitoring

This process is coupled with Oxyle's proprietary analytics technology that allows for real-time monitoring of micropollutants, a truly unique and much-needed offering that helps customers comply with their strict discharge regulations. The aim is to install remotely operated modular, decentralized reactors of varying sizes to meet customer needs from chemical and pharma companies, hospitals, and environmental remediation projects.

Scalable Business Model

Oxyle will earn revenue from licensing our technology to manufacturing partners. Our dominant source of revenue is recurring sales of our catalyst and water quality monitoring service packages. This revenue model ensures a low CAPEX for our customers while guaranteeing sustainable revenue growth for Oxyle.

■ Oxyle AG, Schlieren, Switzerland
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ELEVATOR PITCH

Protecting Precious Water Resources

We are living in an era where we face several existential crises on a daily basis and the lack of clean, pollutant-free water is one of them. At Oxyle, we are providing market-disruptive solutions that remove and detect micropollutants in an efficient, cost-effective, and sustainable manner for our industrial and municipal customers. Flexibility is at the heart of our technology since its conceptualization. Key performance metrics such as ease of use, energy efficiency, and treatment decentralization are always in the focus. With our scalable technology platform, we provide both efficient treatment and monitoring solutions and are ideally positioned to tackle this problem wherever it comes up. Our ongoing customer pilots have shown removal of PFAS to below detection limit. We are building on this momentum to provide products that protect our health and the environment from these toxic forever chemicals. We are exploiting new market drivers such as stricter regulations and growing public pressure to expand our operations in attractive market segments and help a diverse portfolio of global customers. Oxyle has successfully completed several paid pilots with industrial and municipal customers, advanced its technology to TRL8 through on-site demonstrations, and grown to a team of 17 people. Oxyle's team of water experts possesses

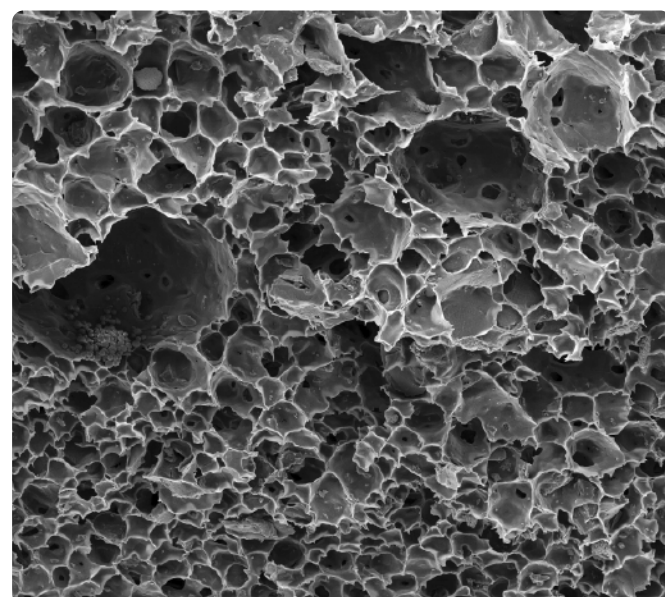
strong expertise in developing and implementing advanced water treatment and monitoring solutions for our customers.

Milestones

- 2020**
 - Founding of Oxyle
 - Commission our first small-scale reactor for on-site customer pilot
 - Grand Prize winner of 2020 Venture Competition
- 2021**
 - Raised 4.1 million CHF in non-dilutive funding
 - Won SEIF Social Innovation award
 - Won Hello Tomorrow Energy & Environment Vertical and 2nd place overall
- 2022**
 - Grown to a team of 15 people
 - Completed ten customer proof-of-concepts and pilots
 - Set up our catalyst production space and analytics laboratories
 - Raised 2.8 million CHF pre-seed round with European and American VCs
- 2023**
 - Commissioned our medium-scale pilot units on customers sites
 - Market entry of our batch reactors in EU



Oxyle's wastewater treatment platform (shown is one of the pilot units) includes modular reactors, nanoporous catalysts, and real-time monitoring services powered by clean energy sources.



Oxyle's novel treatment process is driven by their nanoporous catalysts that oxidize and eliminate micropollutants.