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CHEMISTRY

Green refill

Manufacturers are snapping up chemists who can make their products more environmentally friendly.

BY RACHEL CERNANSKY

When chemist Fred Holzhauser started a job at a cleaning-products company in 2008, his first assignment was to create a tablet dishwasher detergent that contained no polyacrylates, or any other ingredients commonly found in dishwashing products that have negative impacts on human health and the environment. Of course, the

detergent also had to work well in a dishwasher — and to last for months on shop shelves without degrading or losing effectiveness. It also had to be affordable.

First, Holzhauser assembled the best detergent he could put together. Next, he set out to find replacements for the ingredients that he wanted to avoid. He had ideas about possible candidates from his 30 years of experience in formulating industrial cleaners, paints

and coatings, including benign and easily degradable chelates, builders and polymers. He contacted other chemists for further ideas, collected samples and tested them in the company's dishwashers. He spent a year and a half on the project at Method Products in San Francisco, California, and his invention is now sold online and in US stores.

Holzhauser is part of a thriving subfield in chemical manufacturing known as green chemistry. As its name suggests, the field addresses the health and environmental impacts of chemical products and processes.

Many of the chemical ingredients that people and companies seek to avoid can still be used without restriction, but a growing body of scientific knowledge about the effects of these ingredients on human health and the environment has driven consumers to read labels more closely and to educate themselves about what they may be exposing themselves to when they eat, sleep and clean the house. They are pushing manufacturers to reduce use of or phase out components that are proven or suspected to adversely affect their health. Some common ingredients are suspected to be carcinogenic; others have properties that allow them to behave like hormones and interfere with the function of the human endocrine system; still others can devastate fish populations when they end up in lakes or streams.

In many nations, manufacturers and other businesses are required by law to restrict or eliminate carbon emissions and other pollutants. "In previous eras, medicinal chemists would not worry about how they made the molecule, they would just make it," says Chris Moody, a chemist at the University of Nottingham, UK. "Nowadays, they are factoring in principles of sustainability from a much earlier stage."

BROAD BASE

Early-career researchers who want to follow this route and are seeking specialist courses (see 'Field on the up') should focus their training on toxicology, sustainability and life-cycle assessment — the evaluation of a product's environmental impact over its lifespan. Demand for green chemists is greatest in industry, especially in the technology, pharmaceutical, biotechnology and consumer-health sectors. But demand is also emerging in entertainment and office-supply companies. Would-be green chemists should also brush up their skills in marketing, improve their understanding of business and manufacturing and become well acquainted ►

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▶ with all relevant laws and regulations.

“There are going to be some jobs where more of a business background is preferred. In others, there’s going to be a need in life-cycle assessment and toxicology,” says Mark Mason, director of the University of Toledo’s School of Green Chemistry and Engineering in Ohio. “A breadth of skills is required, rather than a one-size-fits-all solution.”

The Green Chemistry and Commerce Council in Lowell, Massachusetts, which represents about 70 businesses around the world, including manufacturers of software, clothing, chemicals and furniture, says that its member businesses seek people who are familiar with regulations and have backgrounds in sustainability and toxicology. “No longer is the most valuable chemist the one who sits in the lab. It’s the one who knows about application and how to think about safety in the design phase,” says Joel Tickner, director of the council and a researcher in community health and sustainability at the University of Massachusetts in Lowell. “It’s the one who knows how to think about, ‘What are the regulatory requirements I have in developing this chemical?’”

Green chemistry may still be niche, but demand for the expertise is no longer restricted to small local companies. The London-based drug giant GlaxoSmithKline, for example, is working to green up its research workforce. Doug Fuerst, the company’s technology-development leader, has been filling positions on a team that develops enzymes for drug production. He has recruited people who have experience in molecular biology, biochemistry and organic chemistry. He also wants researchers who can incorporate principles

of sustainability into their work — recycling the solvents used in chemical processes, say, or reducing the quantities of waste materials produced during manufacturing. Applicants who can connect lab work with the logistics of large-scale manufacturing are particularly valuable, he says. “This kind of experience doesn’t exist in universities, especially in the United States,” he says.

Although more and more companies are looking for green chemists, those opportunities might prove trickier to find than other research jobs in industry. Some companies’ hiring departments may not be familiar enough with the term ‘green chemistry’ to use it in their advertisements, even if the company wants candidates with that kind of training or experience. They may also make mistakes. For instance, a large entertainment company posted a job listing that asked for 25 years’ experience in green chemistry. But, says Anna Ivanova, a chemist at the Green Chemistry and Commerce Council, “the field hasn’t even existed for 25 years”.

SECRET AGENDA

Some hiring executives seek a background in green chemistry but do not mention it on the job description. Roger McFadden, vice-president and senior scientist at the office-supplies chain Staples, takes this tack. The company, based in Framingham, Massachusetts, does not advertise for green chemists, but McFadden likes to know that a candidate can, for instance, find ways to use less packaging or eliminate toxic chemicals from the formulation.

That last is particularly tricky. “It isn’t just about picking a non-toxic ingredient that



Joel Tickner says product-application skills are just as important as chemical know-how.

works,” McFadden says. It is important to know how the ingredient is sourced or produced, and what happens after its disposal. Removing problem chemicals from existing products is a more immediate hurdle. Some of the substances of most concern, such as BPA, used in plastics production, and formaldehyde, used in household products and building materials, are also the most difficult to replace because they are inexpensive and highly effective. Natural alternatives do not always perform as well, and changing one ingredient will sometimes interfere with the rest of the formulation. Many chemicals are used in such a wide range of products that substitutes can be tough to find: a preservative that replaces formaldehyde in a facial cream, for example, may not work in a cleaning product. And the need to replace a common chemical with many alternatives can be costly to the company.

Sometimes companies find that the alternatives are little or no better than the original component, says Tammy Ayers, manager of materials-chemistry strategy and practice at the office-furniture company Steelcase in Grand Rapids, Michigan. “When a product’s been designed with one material, to replace it with another is not usually a simple switch-out,” she says. “The market desires more-sustainable products, but having one come back because of performance failure doesn’t exactly equate to sustainability either.”

In the face of these challenges, companies are on the hunt for employees who can help them to get ahead. Green chemistry is still an emerging field, but opportunities to develop the relevant skills are on the rise. It seems clear that the demand for green chemists is growing. “It’s the pharmaceutical industry, it’s the fine-chemistry industry, it’s the food industry,” says Moody. “They’re all thinking about the sustainability of their products and their processes.” ■

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SPECIALIST TRAINING

Field on the up

Curricula specifically for green chemistry are rare, in part because the subfield is multidisciplinary. But they do exist. In the United States, Yale University in New Haven, Connecticut; the University of Toledo in Ohio; the University of Massachusetts, Lowell; and the University of California, Berkeley, have all launched graduate programmes in green chemistry, as have European institutions such as the University of York, UK, and the University of Copenhagen. Other institutions offer courses as part of a standard advanced chemistry degree.

Some companies have begun to collaborate with universities to develop graduate programmes. Method Products of San Francisco, California, is one of many such collaborators, and works with students at the Berkeley Center for Green Chemistry in California to find sustainable and non-toxic preservatives for its cleaning products.

Other companies have linked up with universities to build entire green-chemistry laboratories: the GlaxoSmithKline Carbon Neutral Laboratory for Sustainable Chemistry at the University of Nottingham, UK, is one example. Students in this programme earn a doctorate or master’s degree in sustainable chemistry and gain hands-on industry experience. “The grads that have come out of our programme get snapped up very fast,” says lab director Peter Licence. They have found positions in research and in science policy, among other areas, he says, as well as at companies such as Johnson Matthey, Unilever and Procter & Gamble.

GlaxoSmithKline is also partnering with the São Paulo Research Foundation to build a green-chemistry research centre in Brazil. It is not known whether the research programme will confer academic degrees. **R.C.**