A sailor stands watch on the *USS Hawaii*, a fast-attack submarine.

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SPECIALTY CHEMICALS

Reshoring sebacic acid production

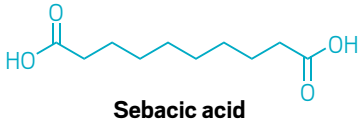
Oregon-based Lacamas Labs seeks to restart US output of the chemical with support from the military

MICHAEL MCCOY, C&EN STAFF

In 2004, the last US producer of sebacic acid closed its plant in Ohio, a victim of low-priced competition from China. US production of salicylic acid ended a few years later, ushered out by declining demand for aspirin, a major derivative.

Now, with funding from the US Department of Defense (DOD), a midsize company called Lacamas Laboratories intends to restart US production of these and other chemicals in Portland, Oregon. The project will be a test of whether the US government can incentivize companies to produce chemicals that have not been made in the country for decades.

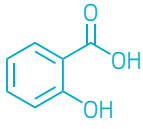
In February, the DOD announced that Lacamas would get $86.2 million to establish production of seven chemicals critical to the US military: salicylic acid and sebacic acid; 4-nitroanisole and 1,3,5-trichlorobenzene, both precursors of energetic materials for explosives and propellants; and diphenylamine, ethyl centralite, and methyl centralite, which help moderate burn rates in explosives.



Sebacic acid

Lacamas is one of seven companies receiving a total of $193 million to reshore US production of 22 chemicals for use by the government and private industry. In September, the DOD put out a call for similar projects that would expand US output of 28 more chemicals.

The department's goal for all the chemicals is to build supply chains that don't depend on adversarial nations. The military is prioritizing products that today come primarily from China and Russia, and to a lesser extent from Iran and North Korea, according to Marta Pazos, a federal contractor who works with the DOD on the reshoring program.

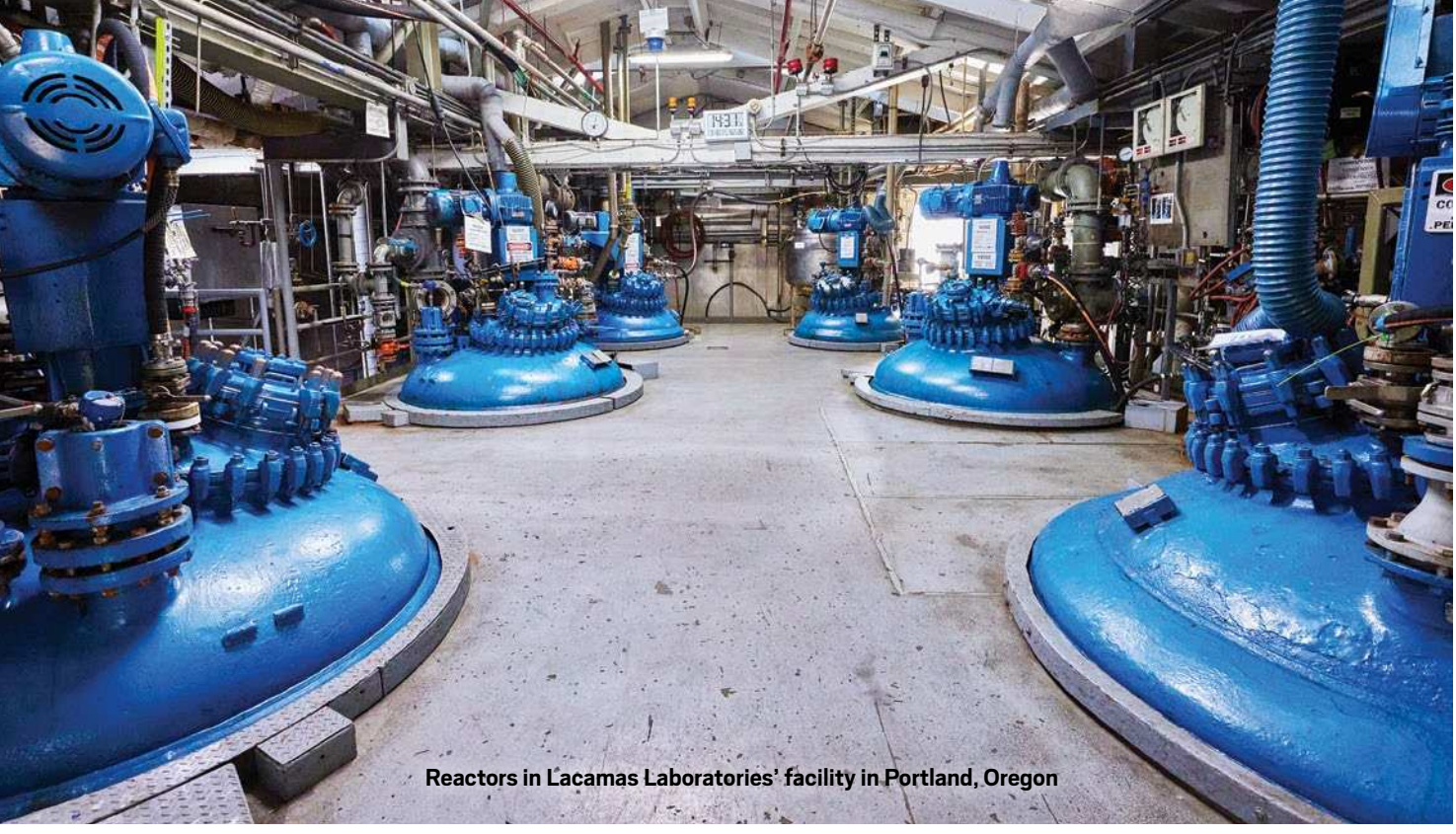


Salicylic acid

Salicylic acid is perhaps the best-known chemical on the DOD list. For years, several US companies made tens of millions of kilograms of it, mostly as a raw material for acetylsalicylic acid, more commonly known as aspirin.

Today, aspirin has been eclipsed as a household analgesic by ibuprofen and acetaminophen and is no longer made in bulk in the US. Dow was the last US salicylic acid manufacturer, producing it in Midland, Michigan, at least until 2008, according to a directory from the time.

But salicylic acid continues to find wide use in the US. Many people know it as an ingredient in acne scrubs, wart medicines, and facial peels. A derivative, methyl salicylate, adds the scent or flavor of mint to personal care products, including Listerine, and gums and candies like Wint-O-Green Life Savers. The DOD uses salicylic acid and lead salicylate as burn rate modifiers for solid rocket propellant, Pazos says.



Reactors in Lacamas Laboratories' facility in Portland, Oregon

Sebacic acid, although less familiar to the average consumer, is perhaps the highest-volume chemical on the list. Pazos says the military wants a domestic source because sebacic acid is needed to make dibutyl sebacate, an ester used in Otto fuel II, a US Navy–developed blend that drives submarine torpedoes.

Beyond this military application, sebacic acid is a raw material for specialty plasticizers such as dioctyl (2-ethylhexyl) sebacate and specialty nylons like nylon 6,10. Its esters and other derivatives go into lubricants and personal care products. And sebacic acid is often formulated into engine coolants as a corrosion inhibitor, according to Jeff Edwards, head of the consulting firm Nauset Mountain. Edwards is a longtime chemical industry executive who spent the decade up to 2021 as president of Innoleo, a supplier of castor oil and castor oil derivatives like sebacic acid.

The US Census Bureau says the country imported 6.8 million kg of sebacic acid last year, and Edwards estimates that less than 5% of that was destined for military uses.

Sebacic acid is also one of the more unusual products on the DOD list because it is derived from castor oil; this natural product is extracted from beans grown mostly in India, though they also come from Brazil, China, and Mozambique.

The acid was made for decades in Dover, Ohio, by the paper company Union Camp. But by the early 1990s, Union Camp was struggling against competition from Chinese firms that produced sebacic acid mainly as a nylon raw material but also for export. In response to a petition by Union Camp, the US International Trade Commission imposed duties on Chinese sebacic acid producers in 1994.

The commission extended the duties in 1999, but in 2002 the Dover facility—by then owned by Arizona Chemical—shut down anyway. Another firm, Genesis Chemicals, began making sebacic acid in Loveland, Ohio, in 2001. Genesis closed that plant in 2004, citing an inability to compete with cheap sebacic acid from China.

Andy Romano, director of sales at Van Horn, Metz & Co., a Pennsylvania-based chemical distributor, says China continues to be the dominant force in sebacic acid, even though that country's manufacturers depend largely on castor oil imported from India. China's Hengshui Jinghua Chemical claims to be the world's largest producer of sebacic acid and says it has annual production capacity of 45,000 metric tons at a factory employing more than 460 workers. Companies in India and Oman also produce the acid, Romano says.

Van Horn, Metz obtains sebacic acid mainly from the Indian firm Jayant Agro-Organics and supplies it to US producers of organic intermediates and corrosion-control products. Romano says prices vary with the price of castor oil and currently range from $2 to $3 per pound (roughly $0.90–$1.30 per kilogram). "The US market is very competitive," he says. "Pricing is aggressive."

Edwards first heard about the effort to reshore sebacic acid in February, during a presentation that Pazos gave at a conference sponsored by the Society of Chemical Manufacturers & Affiliates, a trade association for batch and specialty chemical companies. He was later directed to Lacamas's booth at the event, where he met executives including Jim Tung, the firm's business development manager and a member of C&EN's content advisory board.

Edwards is enthusiastic about Lacamas's participation in the government program. "I would love to see a successful outcome on their behalf to develop a process and begin North American manufacturing," he says. "Not so easy to do, but it would be great if they could accomplish it."

Romano is also encouraged by the program. But he finds it ironic that one US agency, the DOD, is encouraging domestic chemical production while another, the Environmental Protection Agency, is often seen by industry executives as discouraging it through excessive regulation. "You're working at cross-purposes here," he says.

One challenge for Lacamas—or any manufacturer—is the coproducts generated during the production of sebacic acid, Edwards says. Roughly 85% of castor oil is the triglyceride of ricinoleic acid, an 18-carbon fatty acid. Hydrolyzing the triglyceride yields ricinoleic acid and glycerine. Cleaving ricinoleic acid yields sebacic acid, the 10-carbon dicarboxylic acid Lacamas wants, and 2-octanol, an 8-carbon alcohol that Lacamas will also have to

CREDIT: JENNIFER ERICKSON FOR LACAMAS LABORATORIES

contend with.

"It's important that you have a balanced portfolio of customers that can consume everything you are generating," Edwards says. "You don't want to end up with a lot of sebacic acid business and no 2-octanol business, because you are going to have tanks and tanks of it."

Complicating the engineering challenge of developing a sebacic acid production process is the need to process molten sebacic acid into a powder, pastille, or flake form, as it's a solid at room temperature. And to satisfy the DOD, Lacamas must use castor oil from a source outside Asia. Edwards introduced Lacamas to Innoleo, which sent a sample of compliant castor oil to Portland. "There's a genie in that bottle," he says, "and that genie is sebacic acid."

Lacamas executives say they are ready for the genie's tricks.

The company was founded in 1985 by Allen Erickson, a PhD organic chemist who had worked at Crown Zellerbach, a paper and chemical company that had operations near Portland. Erickson is still the CEO of Lacamas, which produces pharmaceutical intermediates and specialty chemicals in a facility with over 120 m^3 of reactor capacity.

Lacamas's initial steps in meeting the DOD's requirements seem to be successful. In May, the American Center for Manufacturing & Innovation (ACMI), an investment firm focused on revitalizing US manufacturing, announced that Lacamas had achieved the first US production in 15 years of an undisclosed precursor for an energetic chemical.

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>
> **—Jeff Edwards,** principal, Nauset Mountain

That precursor chemical is also a raw material for an undisclosed antiviral treatment. In addition to providing the chemical to the government, Lacamas is supplying it to a pharmaceutical industry customer that has switched from imported sources, according to the ACMI.

Success with the energetic chemical aside, Erickson and Tung say they are in the early days of scaling up to meet the DOD's requirements. They emphasize that the funding program requires Lacamas and the other recipients to develop customers beyond the military. Particularly for sebacic acid, "the commercial business dwarfs the military business," Erickson says. The project has already garnered interest from potential private industry customers, he adds.

Tung says Lacamas is working in the lab on synthetic routes to some of the chemicals. He and Erickson don't expect them to be significantly different from what is practiced in China and other countries, but they plan to use flow chemistry when possible and to enhance processes with continuous monitoring equipment and other advanced analytical instruments.

Lacamas is already hiring and is seeing interest from women in what has traditionally been a male-dominated field. "You don't have to be superstrong and brawny to handle these things," Erickson says. "We need the brains more than the brawn."

Ultimately, the executives expect to double the firm's staff of 46 and more than double its manufacturing capacity. They say the project is going to transform Lacamas—and rather quickly. "We don't view this as being a sometime thing," Erickson says. "This is something we see coming on in the next couple years." ■