



Sustainability Has Arrived

A conversation with Biosynthetic
Technologies' Mark Miller



In 1996, Mark Miller founded a company making environmentally safe lubricants from vegetable oil.

"We were green when green was still a color," he said.

Along the way, he learned for himself the well-known weaknesses of these biolubricants. He also discovered the adaptable qualities of the estolide molecule, a biobased synthetic molecule made from organic fatty acids found in plant oils.

Then, investors bought an existing firm called Biosynthetic Technologies, which had cracked the processes for extracting lubricant value from estolides. They invited him to join the team.

"They needed someone to run the company and take it commercial," said Miller, now the company's CEO. "I always liked the technology. I liked the molecule. I liked the team."

Today, Biosynthetic Technologies creates biosynthetic base oils for commercial and industrial lubricants. *Compoundings* spoke with Miller about the present and future of biosynthetic and environmentally friendly lubricants.

Compoundings: You actually like a molecule?

Mark Miller: "I could do a whole presentation called 'Why I like estolides.' They're biobased, coming from plants, which makes them renewable, sustainable and allows users to do the right thing. They have a very good environmental profile, meaning they're readily or ultimately biodegradable. They're not toxic. They're nonbioaccumulative. They don't make a sheen if you spill them in water. They're really good from an environmental perspective, and they give superior performance. It addresses

"The beauty of the estolide is that it's such a customizable molecule that you can do all kinds of really cool things with it."

— Mark Miller, CEO, Biosynthetic Technologies

all the traditional weaknesses of the biobased fluid. It fixes the problems that have been plaguing the biolubricant space for all time."

Compoundings: What have those problems traditionally been?

Miller: "Oxidative stability, which is the ability to operate at high temperature and negatively affects life expectancy of the fluid. Another weakness is hydrolytic stability — the ability to withstand infiltration by water. Most of the biobased fluids have issues if water gets mixed in, and a lot of the opportunities for these biolubricants happen around the water — whether it's maritime, marine construction or excavating. Finally, the cold-temperature performance was also a problem with many of the biolubricant-based fluids, and therefore the biolubricants. The estolide can address all of those concerns."

Compoundings: How is the molecule massaged to make it do all that?

Miller: "It's derived from vegetable oil. We like to say we're vegetable-oil agnostic, but we're mostly focused on soybean oil and castor oil. They seem to be most suited for very simple production. We're starting with a triglyceride — with a fat — and we're reacting that into the estolide molecule. The cool thing about estolides is that because of their reaction, we're able to manipulate the molecule to do what we want it to. We could make it thicker. We could make it thinner. We could increase the oxidative stability. We could make it less expensive by using a different feedstock. It's very, very flexible, and I'm fortunate to have

a team of chemical wizards who know how to do all that."

Compoundings: Have you achieved commercial scale?

Miller: "We've been able to improve the processing, so now we're making commercial quantities. The industry's been very excited about biosynthetic lubricants for years but has always been a little disappointed because they couldn't get their hands on quantities. We're reinvigorating some of that excitement. We recently received our first commercial batch of one of the products, and it looks fantastic. We're giving it out to some of our customers so they can trial it or put it in some of their formulas.

"We're having conversations with prospects who may want us to tinker with it — maybe give it a colder pour point, or less oxidative stability, so we can really dial in the performance."

Compoundings: Which industries seem most interested?

Miller: "So far, people are looking at it in the biolubricant space, primarily in hydraulic fluids and gear oils, which are big sellers for biobased products. It's also important for greases. We've done some work in metalworking and compressors."

Compoundings: How does incorporating biolubricants into products enhance corporate social responsibility initiatives and environmental friendliness labeling?

Miller: "This can be part of any corporate sustainability project. Certain regulations now in the maritime industry mandate use of

environmentally acceptable lubricants in certain applications. The U.S. Department of Agriculture has the BioPreferred program to help increase use of biobased products. This is ticking off all the sustainability boxes.”

Compoundings: Do users need to adapt their operations, or can biolubricants slip easily — so to speak — into existing machinery?

Miller: “Right now, we’re targeting this as a base fluid or component into

finished lubricants. We’re not looking to make the finished lubricant. But lubricant formulation companies and marketers are looking for a direct drop-in to replace very expensive synthetic esters, to give them some solubility and biodegradability.

“We’ve been putting together some prototype formulations because we want to show our customers how this performs in a finished product. We think people are going to be able to formulate fluids so they can market them to customers

who won’t have to change any of the customers’ equipment. You’re not going to ask the end user to retrofit his drilling rig or excavator or lawn mower. It’s got to be compatible with traditional equipment. Otherwise, people are not going to do it. We’re trying to demonstrate in base performance characteristics, whether it’s wear or oxidative stability or field compatibility or pour point, that we meet industry requirements as an oil and in prototype formulations.”

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Performance and Responsibility



Biodegradable and environmentally friendly lubricants should be a no-brainer for manufacturers and formulators looking to enhance their social responsibility ratings.

After all, “sustainability is increasingly a critical lever for driving business value,” said Pierre-Francois Thaler, co-founder and co-CEO of EcoVadis.

With its corporate social responsibility (CSR) scorecard, EcoVadis offers tools for rating such factors as environmental impact and sustainable procurement. Companies can use the resulting scores to engage customers, reshape corporate culture and showcase measurable environmental impact.

However, lubricant manufacturers and formulators know that the scientific properties of environmentally friendly fluids play games with performance. When lives are at stake and entire industries

demand perfection, performance takes priority over CSR.

Consider the low-temperature challenges that have always been a factor in base stocks. The diversity of biosynthetic lubricants may magnify those issues and call for specialized pour point depressants.

As specialty chemicals manufacturer Evonik noted, “All biodegradable fluids are not created equal.” Evonik’s experience is a case study in overcoming the challenges of biodegradable fluids and helping companies derive the sustainability benefits of environmentally friendly lubricants.

Use biodegradable fluids in cold temperatures, and it’s not only the feedstock aspects, but also the manufacturing process that can influence cold-temperature performance, Evonik noted. In engines, lower fuel economy and lubricant starvation related to air binding or high viscosity can occur. Hydraulic fluids exhibit lower efficiency, sluggish performance, rough movement or – in extreme cases – cavitation. Transmission fluids can show rough shifting, poor lubrication and lower fuel economy.

No matter the application, high viscosities at low temperatures left untreated can lead to equipment damage or failure. Specialized pour point depressants and viscosity-index improvers address these challenges.

As new sources of biobased stocks emerge, it’s important for manufacturers to develop pour point depressants that optimize flow properties and create cost-effective additives for formulators, keeping pace with a market hungry for lubricants that deliver performance paired with environmental benefits.



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Compoundings: What are the major hurdles to overcome in the marketplace and in formulations?

Miller: “We just figured out how to make commercial quantities. That’s always been an issue, but now we’re scaling up to volumes. If you get a customer who’s buying into your product and has a commercial success, you have to be able to support them. The only thing worse than not having anybody embrace the product is having everybody embrace the product and not being able to supply it.

“The beauty now is that we’re outsourcing our manufacturing. We can scale up easily by just bringing on more manufacturers. It’s a very simple process, and we don’t have to build a

new plant. We don’t have to find new people. We know who’s out there and can give the industry whatever it needs very easily and very quickly.”

Compoundings: What have been the hurdles to scaling up?

Miller: “Building a brand-new plant would have been expensive and time-consuming. We’ve developed a batch process. We can use hardware that exists with the manufacturer’s in a simple and cost-effective and scalable way. It’s really important to be able to supply the product and not have to build a several-hundred-million-dollar facility right out of the gate.”

Compoundings: What’s on the horizon in terms of research and potential?

Miller: “We are 100% laser-beam focused on production, getting products out to the lubricant marketplace and working with customers and prospects to incorporate into their products. We’re also focused a little bit on looking at other markets — personal care, plastics and maybe rubber. We’re always trying to move in a variety of different directions within the molecule to make it better, faster, cheaper — to improve the quality, to improve the pour point, to keep stretching what it can do. Longer changeout intervals is another environmental aspect that’s coming. The beauty of the estolide is that it’s such a customizable molecule that you can do all kinds of really cool things with it.

“Everybody’s chasing the holy grail that is engine oil. It’s always a difficult market because the testing is so expensive and the conditions are so severe. We want to work with the major oil companies to formulate this into their BioPreferred products.”

Compoundings: Are you tracking any legislative or regulatory developments?

Miller: “We’re always watching regulatory and compliance requirements, and they change on a daily basis. We’d love to see more governmental initiatives like BioPreferred mandating environmentally preferred fluids. I don’t see any coming down the pike, but you never know.”

Compoundings: Sounds like you see a future in biosynthetics.

Miller: “There’s no doubt that the environmental movement is coming. There’s no doubt that the BioPreferred program is going to have more impact. The concept of sustainability is not going away. It’s an idea that’s arrived and is only [going] to get bigger.”