Killing fungi softly, with ozone

Oxygen is cheap and plentiful--and a company in Livermore, Calif., is using it to kill pests on your fruit.

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Published: March 15, 2007, 4:00 AM PDT

Oxygen--it's the ultimate weapon, at least according to Novazone.

The Livermore, Calif.-based company has developed systems that kill fungi and other microorganisms on vegetables, fruit and in bottled drinks without altering appearance or taste. Novazone's principal agent: ozone, the three-atom molecule of pure oxygen.

High Impact

What's new:
Novazone is using ozone, the three-atom molecule of pure oxygen, to kill pests on fruit, vegetables and in bottled drinks.

Bottom line:
Demand for the company's systems, which sell in the $100,000-plus range, is being driven indirectly by consumers, as organic foods become more popular.

Ozone-disinfecting systems for keeping hot tubs or individual rooms clean have been around for several years. But by harnessing ozone for industrial applications, Novazone says it can help reduce the amount of chemicals food producers spray on their harvests, as well as take a big chunk of the $36 billion market for industrial pest killers. The spinach recall of 2006, which happened because growers didn't adequately clean their products, underscores the potential market, according to Dave Cope, Novazone's CEO.

"If you use enough chlorine, you won't have E. coli in your spinach, but people want fresh, safe food," said Cope, who came on board with the company in 2004 after spending years in the computer industry. "When you get really smart, you use natural processes. This is not some tree-hugger perspective."

Chances are, you've indirectly experienced the company's products. The makers of Dasani, Arrowhead and Aquafina have adopted Novazone's systems to kill the microbes in their bottled waters. One of the manufacturers even uses ozone to disinfect the bottle as well as the water.

A significant percentage of the California citrus crop as well as the produce coming from Chile and Mexico get "Novazoned" while in storage. Colgate-Palmolive and others also use it to purify contact lens solution, toothpaste and toilets.

"All the things you never think about but that you need to be mold-free" is how Cope described the market for Novazone systems.

Novazone also can be viewed as a poster child for the connection between Silicon Valley and clean-tech companies. Although many people may not have heard of it, Novazone has been around for years. In its earlier days, however, the company didn't focus on any particular application; it made ozone systems for zoos and aquariums and a number of other one-off productions.

Then, in late 2004, Foundation Capital, among others, invested in the company and brought new executives, among them Cope, a veteran of Internet-era darling Marimba, as its chief marketing officer. (Cope became CEO of Novazone in 2006.) The company decided to concentrate on the food and water business and expand from there as cash flow and success permitted.

While Novazone has carved out a niche in ozone, the company competes in the wider market for new cleaning and purification technologies for food, water and other substances. General Electric and Siemens have made significant investments in this area, and a number of start-ups have begun to emerge.

Cope declined to state current revenue but said it is growing. So far, the company has raised $17.6 million in venture capital. And it's refining its technology all the time.

How it works

"Killing is about time and concentration," he said.

Novazone's system, which sort of resembles a still, essentially exploits the instability of ozone. Ordinary oxygen molecules consist of only two atoms. The third atom in ozone only stays attached until it can react with, or oxidize, another substance. If that substance is a bacteria cell or fungi, it's doomed; the spare oxygen atoms in the ambient ozone attach to the cell walls of microorganisms and crack them open.
The raw material for the system, oxygen, gets harvested from the air. A ventilator from the top of the unit sucks air from inside a room. It then compresses the air and filters out nitrogen and moisture to get pure oxygen. The oxygen is then passed through corona discharge cells, which deliver a jolt of electricity that turns O2 into O3.

"Think of that as a mini-lightning storm," Cope said.

The ozone is then piped into water, or sprayed as a gas over fruits and vegetables. The leftover from the process are oxygen and nitrogen, making the process environmentally safe. By contrast, chlorine leaves a chemical trace on fruit and requires employers to use expensive handling procedures. Ozone can also be piped in on a regular basis.

Sensors monitor the flow of ozone so that it stays within a minimal range of 100 to 300 parts per billion. Large concentrations of ozone can be harmful to people. A good portion of the

company's key intellectual property is based on software to get the sensors, computers and the ozone manufacturing system to interoperate dynamically.

Demand for the company's systems, which sell in the $100,000 and up range, is largely being driven indirectly by consumer demand. Organic foods are the fastest-growing segments in agriculture and the grocery market, and such foods can't be treated with chemicals. Several companies such as Agraquest have developed biopesticides that kill field pests with hormones or other bacteria.

Novazone doesn't concentrate on in-field killing like biopesticide companies. Instead, it focuses on making equipment for post-harvest storage and processing. Right now, the products are mostly installed in warehouses and cool rooms, where apples or lemons might sit for a year before making it to store shelves. One cherry grower has already replaced its traditional cleaning system--a vat filled with water and chlorine--with an ozone bathing system.

Soon, Novazone will come out with mobile units that can spray ozone onto fruit being ferried by trucks. Systems will also be prepared for large, big-box retailers.

Along with curbing chemicals, ozone can cut the amount of food that gets wasted, a major problem for food producers. In 2006, roughly 20 percent of the grapes picked in Chile never made it to store shelves because of pathogens.

In a test conducted by the U.S. Department of Agriculture, Anjou pears were locked in cold storage for six months and treated by Novazone's ozone system. Airborne mold was reduced by 100 percent compared with ordinary circumstances, while mold on fruit bins was down 95 percent. Food decay was reduced significantly, as well.

Three weeks after coming out of the locker, the pears were tested again, this time for skin and surface pressure. The ozone-treated pears were slightly harder, and thus would last a few weeks longer on a store shelf than untreated pears. The Food and Drug Administration approved ozone as a substance that can disinfect food through contact in 2001. Field studies at Paramount Farms (using kiwifruit) and Sunkist (using lemons) found that the fruit shelf life increased by several weeks.

Along with killing pathogens, ozone can slow down natural ripening processes. Ethylene, a gas that gets released by bananas and other substances, can cause apples, pears and other fruits to ripen at a faster rate. Ozone converts ethylene to carbon dioxide and thereby arrests the ripening process, allowing the fruit to live longer.