

## Making oxygen in a backpack

by Terri Somers

Manny Rappaport's freedom and mobility decreased drastically when doctors said he needed to be constantly tethered to an oxygen machine because of lung disease.

Something as simple as a quick trip to the grocery store became an angst-producing exercise for the retired San Diegan: Would the two-hour supply of oxygen in his portable tank outlast his errand? What if an unexpected traffic jam prolonged his trip?

"Driving up to Las Vegas or Santa Rosa meant I needed a whole set of (oxygen) canisters," Rappaport said. And traveling on an airplane was even more problematic because security precautions blocked him from bringing his own oxygen.

But Rappaport thinks he has found a solution. The 76-year-old said he regained much of his mobility when he started using the Eclipse, a machine made by a San Diego company that pulls oxygen out of the air.

OXYGEN ON THE GO - Inset, SeQual's Eclipse is a 17-pound oxygen generator the size of a backpack. Main picture, Jody Watson of SeQual works on a filtration unit. CNS Photo by Earnie Grafton. "I can place this machine in the back seat of my car, plug it into the lighter and travel for as long as I want," he said. "When I'm there, I just remove it from the car, take it into the motel and plug it in, or use it on battery."

Rappaport is one of an estimated 1.5 million people in the United States who are prescribed oxygen because of severe breathing disorders. They make up a \$5 billion-and-growing market that SeQual wants to tap. But the privately held company, founded in 1991, faces tough competition that includes Respironics and Sunrise Medical, both large medical-device companies with numerous product offerings in several areas of patient care.

SeQual's story echoes that of many companies in the life-sciences sector: Its technology has the potential to shake up the market, but the company almost ran out of cash before finally catching its big break.

The basic technology has been around since the 1950s. It involves taking in ambient air - a mixture of oxygen and nitrogen - and running it through a sieve to separate the two elements. The nitrogen is blown out as waste, and the oxygen is pumped through a hose to a patient. Inside these machines, called oxygen concentrators, are cylinders filled with little beads that act as sieves. Valves at the top of each cylinder allow the air to be pushed in and out of the cylinders. Father-and-son inventors Charles and Ted Hill developed a rotary valve that can be used alone or coupled, allowing SeQual to build a machine with several smaller cylinders, fewer valves and 200 fewer connections and fittings.

SeQual's technology, which comprises 15 patents, gave the company the ability to make its concentrator smaller, lighter and more efficient at oxygen production than other machines. The company received its first round of financing from "angel" investors in 1993. The first commercial application of its technology was with Caire, a Minneapolis manufacturer of oxygen concentrators, which introduced two models around SeQual's technology in 1997. They were large, stationary units.

But Caire soon found the machines too expensive to manufacture. Meanwhile, reimbursement for the machines was cut by Medicare. Caire bowed out of the partnership, leaving SeQual perilously low on cash and with a quarter's worth of inventory in its warehouse. To stay afloat, executives had to find a marketing opportunity for those machines, said Don Miller, SeQual's founder and senior vice president.

Unbeknown to SeQual, Caire had sold about 100 concentrators to Teijin, Japan's largest maker of oxygen concentrators. Teijin had tested SeQual's concentrators rigorously and was impressed. In early 1998, during what SeQual's executives thought were the dying days of the company, Teijin officials called and said they might be interested in buying more units.

"We had them in here and tried not to seem desperate," said Jim Bixby, SeQual's chief executive. "We told them we needed a half-million dollars within 60 days to close the deal. On the 60th day, we got the check so we could make the units."

Teijin decided to incorporate SeQual's technology into its entire product line. In exchange for exclusive Japanese licensing rights to SeQual's technology, Teijin invested engineers and money in SeQual. Together, the companies pushed forward on an idea SeQual's engineers had been itching to pursue: the design of a smaller, portable concentrator.

Meanwhile, with new credibility for their technology, SeQual reorganized and began attracting other investors and collaborators. In February 2006, the company closed a \$4.35 million equity financing. In 2002, the Army contracted with SeQual to develop a lightweight, battery-operated oxygen generator for the care of combat casualties. The research led to the Eclipse.

The 17-pound Eclipse, about the size of a student's backpack, hard-sided and connected to wheels and a retractable handle like carry-on luggage, was introduced in August. The company said the product was the result of five years of work and \$12 million.

Since the company is private, Bixby won't release sales and revenue figures. He said recently that in six months the company's sales had increased 250 percent.

In August, the Army invested an additional \$5 million in SeQual for the development of the next-generation concentrator. A prototype is the size and shape of the small, portable oxygen tanks that the military uses in the field.

It's a common-sense investment for the military, which now ships tanks of oxygen from Houston to combat zones and field hospitals in Iraq and Afghanistan.

"Every 5 pounds of oxygen we ship anywhere in the world goes in a 125-pound steel canister," said Mark Arnold of the Army's Medical Research and Material Command at Fort Detrick, Md. "A typical patient will go through one canister a day."

And then there's the desire to get volatile oxygen canisters off military helicopters.

SeQual officials happily show visitors a video of tests that the Army conducted to compare the volatility of the oxygen tanks versus the Eclipse. Shooting the oxygen container created a spectacular explosion.

All it did to the Eclipse was put a hole in it. The Eclipse is dwarfed by the 50-pound, stationary oxygen concentrators, currently the standard of care, that sit obtrusively in people's homes.

"If you weren't deaf, you would be after using these," said Ed Bright, a 69-year-old Florida man who used a large concentrator to treat his breathing disorder. He switched to the Eclipse in July. "Next week I'm going to a wedding in Jacksonville, and I've got a cruise coming up," Bright said. "I won't have to call ahead and arrange to have some 50-pound gorilla waiting at the hotel. Now that I can bring that puppy along, I'm gone."

Although the Eclipse costs \$3,500, Bixby contends that over time it saves money. All oxygen concentrators are sold to middlemen - companies that supply patients with their specific system and bill Medicare. Stationary systems and portable oxygen canister systems require the supplier to make monthly trips to patients' homes, restock canisters and service equipment.

The Eclipse, for which Medicare approved payment in October for in-home and portable uses, doesn't require tank restocking. In September, the Federal Aviation Administration approved the use of the Eclipse on airplanes, but individual carriers must now approve its use. That's good news for oxygen users such as Bright who love to travel. Before the Eclipse, Bright had to arrange and pay to use portable oxygen tanks provided by the airlines.

Once Qantas Airlines approves the Eclipse, Bright said, he's going to figure out a way to use the machine, which has a four-hour battery life, to fly to New Zealand.

Fourteen-year-old MacKinzie Kline is happy using the Eclipse a little closer to home.

The San Diego teen, born with a congenital defect that makes her heart pump far less oxygen through her system than normal, has aspirations of playing golf on the women's professional circuit. She was ranked fifth in the country among 14-year-olds last summer, despite her condition's making it taxing for her to walk 18 holes.

In 2006, MacKinzie successfully petitioned the U.S. Golf Association for permission to use a cart in the U.S. Girls Junior Championship tournament.

She used to keep her portable oxygen generator and tank in the cart with her to use between strokes to increase the oxygen saturation level in her blood to normal levels. Late last year, she switched to the Eclipse.

The bouncing around in the cart doesn't seem to affect the Eclipse, and MacKinzie doesn't have to worry about changing oxygen bottles during a round.

"It's really cool that it just gets oxygen from the air," she said.

The teen also appreciates that it's unobtrusive.

"It doesn't look like oxygen back there," she said. "It just looks nice."

*Making oxygen in a backpack by Terri Somers*