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One giant leap

Novair's ionic oxygen generator

By **Anthony Wright**

During the height of the Covid-19 pandemic, global demand for medical oxygen surged dramatically and challenged supply chains – most especially in many low- and middle-income countries.

At the peak of the crisis, these countries required an additional 1.1 million cylinders of oxygen daily, but consistent delivery of oxygen cylinders was difficult in many contexts – and production wasn't keeping up in any case.

Just imagine how many lives might have been saved if the situation had been different, and oxygen was easier to produce in many more locations.

Now, at least, that promised leap forward looks closer than ever. Novair, a French medical oxygen technology company, has been involved in developing a solution that the firm is calling "the greatest technological innovation in air gases since the invention of cryogenic distillation."

A bold claim, make no mistake. But it is one that Laurent Zenou, CEO of Novair Group, stands by.

"We decided to use this line because when you have this technology you say, 'okay, what's the point of considering any other technology when ours has just advantages and no drawbacks?'"

What is the tech exactly? It is an on-site ionic oxygen generator that produces ultra-pure oxygen (99.99% to 99.999999%) from ambient air. The plug-and-play generator was jointly developed with American Oxygen (AMOX) and is based on technologies developed in partnership with the space agency NASA for use by astronauts on the International Space Station (ISS).

Novair got involved when it was selected by AMOX during its search for an industrial partner to commercialize the technology for use well beyond the world of astronauts and space stations.

The outbreak of the Covid-19 pandemic accelerated the design of a first demonstrator to produce medical oxygen on Earth, with prototypes currently capable of delivering around 34 liters per minute of ultra-high-purity oxygen.

"American Oxygen is a startup founded in 2018 which specializes in ceramic technology," says Zenou. "The founders of the company have decades of experience in ceramics in general, and so they have been working with NASA during the past five years on implementing that ceramic technology to produce oxygen for space use."

Known as the Medical Ceramic Oxygen Generator, or M-COG, the device's development was spearheaded by NASA engineer John Graf, who wanted to create a new type of oxygen generation system as a form of in-situ resource utilization (ISRU).

By harnessing the potential of ISRU, the premise is that astronauts can generate gases on the Moon or the ISS instead of taking the needed supplies from Earth.

As the name suggests, traditional pressure-swing adsorption (PSA) technology relies on an air compressor to facilitate the efficient generation of oxygen from ambient air.

The M-COG technology works by using a ceramic ion transport membrane to selectively isolate oxygen atoms. The oxygen produced is then generated under pressure without the need for a compressor.

"The idea … was to produce oxygen through water electrolysis, and then use the ceramic to purify it to the high grade that was necessary to feed the space suit," explains Zenou, who sees the technology as a 'revolution' with two key parts.

"In our world, to make pressure you need compressors somewhere, and to [have] … a technology that can build pressure – and in particular oxygen – without using any compressor is just incredible."

The second aspect of the revolution is from the perspective of the customer, who has two choices: either purchase gas delivered by trucks in cylinder or liquid form, or invest in equipment to produce gas on-site.

"In this case, until now the purity of the gas produced is lower – and because it's a machine you have to take care of the maintenance of the equipment," says Zenou.

"Now we [have] come to the market with a product with no maintenance at extremely high purity and that is extremely easy to install. It's product you can plug in and just forget about."

The company also claims another advantage of its technology: the size. A typical container built to house a PSA plant is around six meters high and 2.5 meters wide. Contained within a cabinet, the ionic oxygen generator is just two meters high and 50cm wide.

Cost-competitive

So where does Novair's breakthrough technology sit compared with existing methods of oxygen supply? Admitting that – as with any new product – initial costs will be higher, Zenou says that the company will be cost-competitive with oxygen cylinders from the get-go.

"Even with the relatively high cost of the technology, when we start we will be competitive with oxygen cylinders and then our goal is to reduce the cost enough to be competitive with liquid oxygen and PSA plants."

He emphasizes that Novair does not want the generator to become a 'luxury product' that is restricted to a niche market, but rather to be "competitive and interesting" within just a few years.

With global oxygen projected to be worth around $128bn by 2028, how does Zenou see the ionic oxygen technology positioning itself within the growing market?

"We have not yet really evaluated what will be the addressable share of it because obviously you have the very large consumers who consume tons or hundreds of tons of oxygen per day," he says.

> "The pandemic highlighted the critical need for medical oxygen, yet supplies remain limited in low-and middle-income countries"

"We will do the best from the financial standpoint of the group, but we also see it as a mission, because there are a lot of countries where getting oxygen is still a challenge, and we see this product as a kind of infinite source of oxygen."

The pandemic highlighted the critical need for medical oxygen, yet supplies remain limited in low-and middle-income countries.

Despite efforts over the past four years, a World Health Organization (WHO) October 2023 study indicates services in these regions are still below-par.

WHO estimates that non-invasive respiratory support is needed for 1% to 3% of patient beds and up to 25% of ventilator patients, though these trends are preliminary.

The case for new, potentially safer technologies is also supported by all-too-common hospital fires in some locations. In May, five oxygen cylinders exploded in a Delhi hospital fire in India, causing the deaths of six newborn babies.

As the fire spread, 27 oxygen cylinders stored near the reception and front porch of the hospital also ignited and burst, making a bad situation much worse.

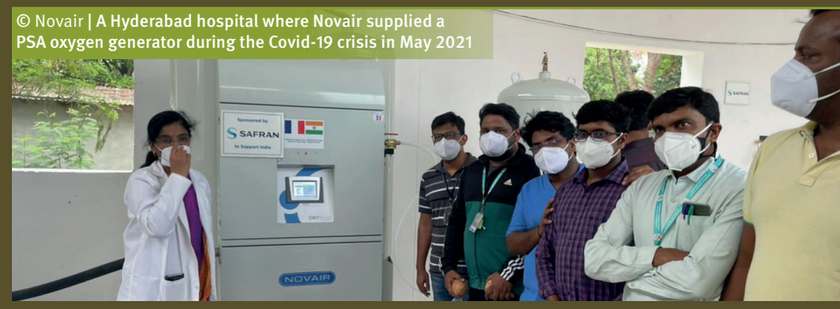
According to the National Institutes of Health, since the outbreak of the pandemic in March 2020, incidents of oxygen-related hospital fires in various countries around the world have caused over 200 deaths.

Looking ahead

To scale up the technology and to compete against existing methods of medical oxygen supply, Novair is targeting widespread commercialization through health partnerships or a distributorship.

"We think it does not happen often that you can get into your hands a technology that can have such an impact on the market," says Zenou. "We will look for a distributor and we will look for partners and we are open to people who come to us and say, 'yes, we are interested in this technology – let's talk.'"

When it comes to providing oxygen-at-scale to countries that need it most – especially during times of crisis – PSA may still be king, but can it really compete with an infinite source of oxygen? **gw**



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