Novair ionic oxygen generator marks ‘greatest innovation’

By Anthony Wright

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During the Covid-19 pandemic, the global demand for medical oxygen surged dramatically, highlighting major challenges in its supply and production, especially in low- and middle-income countries (LMICs).

The pandemic led to an unprecedented rise in the need for medical oxygen. According to the World Health Organisation (WHO), LMICs alone required an additional 1.1 million cylinders of oxygen daily at the peak of the crisis. This sudden surge overwhelmed existing production and supply chains.

Bottled gas deliveries slowed down due to logistical challenges, including transportation restrictions and lockdowns. In many regions, especially rural and remote areas, consistent delivery of oxygen cylinders was nearly impossible due to poor infrastructure.

Many countries also faced severe limitations with their oxygen production facilities. For instance, many facilities were either underfunded or outdated, and some even failed to meet the increased demand.

Hospitals often lacked the necessary equipment such as oxygen concentrators and pulse oximeters, while maintenance of existing equipment was often lacking due to a shortage of trained biomedical engineers and technicians.

Given the sheer scale of the pandemic and its death toll, it is worth considering how many lives could have been saved if hospitals and healthcare facilities were already equipped with suitable technologies.

Technologies that could cope with the increased demand for oxygen; technologies that reduce or eliminate the need for slow and oft-disrupted bottled gas deliveries; technologies that could generate an infinite source of oxygen.

Enter Novair, a French medical oxygen technology company that has developed a solution that the firm calls ‘the greatest technological innovation in air gases since the invention of cryogenic distillation.’

A bold claim, it must be said. But a claim that Laurent Zenou, CEO of Novair Group, assures me is an accurate one.

“We decided to use this bold statement 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’?

The technology in question is an on-site ionic oxygen generator that produces ultra-pure oxygen (99.99% to 99.999999%) from ambient air.

Jointly developed and marketed with American Oxygen AMOX, the new plug-and-play generator is based on technologies developed alongside NASA for use by astronauts on the International Space Station.

Novair was selected by AMOX during its search for an industrial partner to commercialise the technology into a product that could be sold on the market.

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 litres per minute of ultra-high purity oxygen.

“American Oxygen is a startup founded in 2018 which specialises in ceramic technology,” explained 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 us.”

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 utilisation (ISRU).

By harnessing the potential of ISRU, astronauts could 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 for them 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,” explained Zenou, who sees the technology as a ‘revolution’ split into two key parts.

> “The outbreak of the Covid-19 pandemic accelerated the design of a first demonstrator to produce medical oxygen on Earth”

“One is, in our world, to make pressure you need compressors somewhere, and to learn that there is a technology that can build pressure – and in particular oxygen – without using any compressor is just incredible.”

The second aspect revolves around the perspective of the customer, who has two choices: either purchase gas delivered by trucks in cylinder or liquid form, or invest in equipment which will produce gas on-site.

“But in this case, the purity of the gas is lower and because it’s a machine, you have to take care of the maintenance of the equipment,” said Zenou, who added that such products are complex, require a lot of maintenance and produce lower purity gas.

“Now we come to the market with a product with no maintenance at extremely high purity and extremely easy to install because 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 metres high and 2.5 metres wide. Contained within a kind ▸

of cabinet, the ionic oxygen generator is just two metres high and 50cm wide.

Cost-competitive

So where does Novair's breakthrough technology compare with competing methods of oxygen supply? Admitting that – as with any new product – initial costs will be higher, Zenou reveals 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 emphasised 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.

However, with global oxygen projected to be worth around $128bn by 2028, how does Zenou see the ionic oxygen technology positioning itself within a rapidly expanding 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 tonnes or hundreds of tonnes of oxygen per day," he said.

"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 Covid-19 pandemic highlighted the critical need for medical oxygen, yet supplies remain limited in LMICs, which often lack knowledge of their requirements.

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

WHO estimates that non-invasive respiratory support is needed for 1-3% of patient beds and 2-25% 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 LMICs. In May, five oxygen cylinders burst in a Delhi hospital fire in India, causing the deaths of six newborn babies.

The Delhi Fire Service suspects a hospital wiring short-circuit caused the fire. As it spread, 27 oxygen cylinders stored near the reception and front porch of the hospital ignited and burst, engulfing the facility in flames.

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 currently targeting widespread commercialisation through health partnerships or distributorships.

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"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," said Zenou. "We will look for distributors, 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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