

The highest quality gas for additive manufacturing

An additive manufacturing company specialising in bio-compatible titanium 3D printing is making strides in the medical industry. *Manufacturers' Monthly* speaks with Additive Engineering about its journey so far and the integral working relationship it has forged with Air Liquide.

HUGH Tevelein was front and centre during Australia's first additive manufacturing boom. From a modest shop running on a limited budget, the company he worked for at the start of his career turned into one of Australia's biggest 3D printing businesses.

After reflecting on what he would like to do through the covid pandemic, Tevelein began his own company called Additive Engineering with a main mission to support the medical industry. Recognising a weakness in the market for customised implants, he rounded up some private investment and pulled the trigger on the greenfield business.

Start-ups are complicated. A clear plan is required to navigate the challenges a new player faces, and Tevelein identified early the necessity of securing the specs for three 3D laser-based titanium printing systems. The quality machines which are manufactured by GE in Germany require an inert gas to be able to operate safely and efficiently.

During the printing process, a laser is shot into titanium powder which is finer than icing sugar. If this process was to happen in a usual oxygen environment, it would explode, so an inert gas of high quality is required.

Working in the medical industry from the get-go, quality assurance was pivotal for Additive Engineering. When contacting different companies for the argon gas supply required for its laser systems, Tevelein considered who could work with the new business to help build its reputation as the stand-out for supplying this kind of titanium implants.

"Some companies immediately said they couldn't help us, while others threw out a price with no consideration of integration or exactly what we needed," he said. "When working with Air Liquide, at first I thought we would be a small business to them and we definitely received that from other companies, but I found that Air Liquide took the time and it's clear they see additive manufacturing as something that will continue to grow."

Air Liquide leverages years of



A 3D-printed titanium dental implant.

investment in research and development to have the most proficient processes, which in turn leads to the highest quality of gases for different applications. By continuing to push the innovation envelope, its Argon is 99.999 (5x 9s) of purity, which is higher than its competitors.

"They made sure we had all the right gases at all the right purity levels," he said. "They have the purest Argon levels on the market which is exactly what we needed."

The high quality of argon ensures machines aren't over-exposed to oxygen or other gases, which increases their longevity. Crucially, the gas supply better the quality of the end-result of the manufactured part, in this case creating pure titanium implants for medical customers – a lower quality gas supply would result in more burning and carbon elements.

This quality improves the consistency

of the final product, which is extremely crucial in both medical and aerospace industries. Reduced clumping of titanium powder also improves the recovery of unused powder which in turn leads to more sustainable manufacturing.

According to Tevelein, the purity of the Argon gas wasn't the only benefit of choosing Air Liquide.

"On top of that, they were able to provide the gas at a very competitive price and spec up the whole supply system and delivery to the machines – we had a full fit-out of gas lines in our facility considering every little detail. At the end of the day, we were extremely happy with everything Air Liquide has given us from end-to-end."

After identifying the quality, pure argon as a priority, Additive Engineering was able to put in place the next steps to grow the business. Additive manufacturing will continue to grow,

transitioning from prototypes or one-offs to more mass production here in Australia.

"Traditional forms of production such as injection moulding, CNC machining and casting are still there and are not going away. But 3D printing is opening up a few more doors in terms of real mass customisation," Tevelein explained. "For patients for customised surgeries, it's unrivalled and there's no other way of doing what we do."

3D printing can create personalised implants specific to every individual patient at fast speeds. Having a custom medical device improves the chances of a successful surgery and can make a life-changing difference for the patient. Additive Engineering is supported by a group of professionals experienced in working with bespoke 3D printed implants for procedures including dental implant fixtures, bone loss, orthopaedic,



Hugh Tevelein explains metal 3D printing to industry.

hand/wrist/ankle surgeries, custom prosthesis and reconstructions for jaw joint osteoarthritis, trauma and cancer patients.

“The benefit of 3d printing is we can create a customised object very easily and quickly. We’re usually turning parts around for surgery within two days,” he said. “Someone might have gone through a trauma or accident and have a broken jaw, for example. The patient will have a CT-scan, the bio-medical engineer then plans the surgery and figures out what needs to be replaced or moved and a CAD file is generated and signed off by the surgeon. That file is passed to us, we manufacture the part which is delivered into surgery and put into the patient.”

Titanium is one of the few metals which is bio-compatible with the human body, lending itself perfectly for printing implants.

“Bones are lightweight but strong. Stainless steel has been used traditionally and is great for strength but they’re heavier. Titanium is that sweet spot that feels comfortable in the body,” he added.

“Suitability for the medical industry really comes down to process control – having complete control of all the parameters which go into making a part. It is really specified and we need to be really regimented in our internal processes.”

Leveraging off its success in the medical space, serving the aerospace industry has been a natural leap for Additive Engineering. The aerospace

industry is the largest customer of titanium alloy products. Titanium’s high strength-to-weight ratio, high temperature and corrosion resistance are favourable for applications including airframe structures as well as smaller components for jet/turbine engines, rotors, landing gears and compressor blades.

“We’re definitely still exploring other markets but we really just want to keep consolidating ourselves in being the number one provider for medical items in Australia,” Tevelein said. “Air Liquide has been fantastic working with us and we are looking forward to continuing on that path with them on board.”

Working towards a sustainable future

“ADVANCE”, Air Liquide’s new strategic plan for 2025, is a milestone in the company’s history. It places sustainable development at the heart of the Group’s strategy and is built around 4 pillars;

1. Delivering strong financial performance

With ADVANCE, Air Liquide is taking action today while preparing the future. The Group is rising up to an ambitious challenge: maintaining its growth dynamic and improving its profitability while meeting its commitments to reduce CO2 emissions and investing in the markets of the future.

2. Decarbonising the planet

ADVANCE will enable Air Liquide

to consolidate its leading role in the decarbonisation of industry and the advent of a low-carbon society in which hydrogen plays a decisive role.

3. Unlocking progress via technology

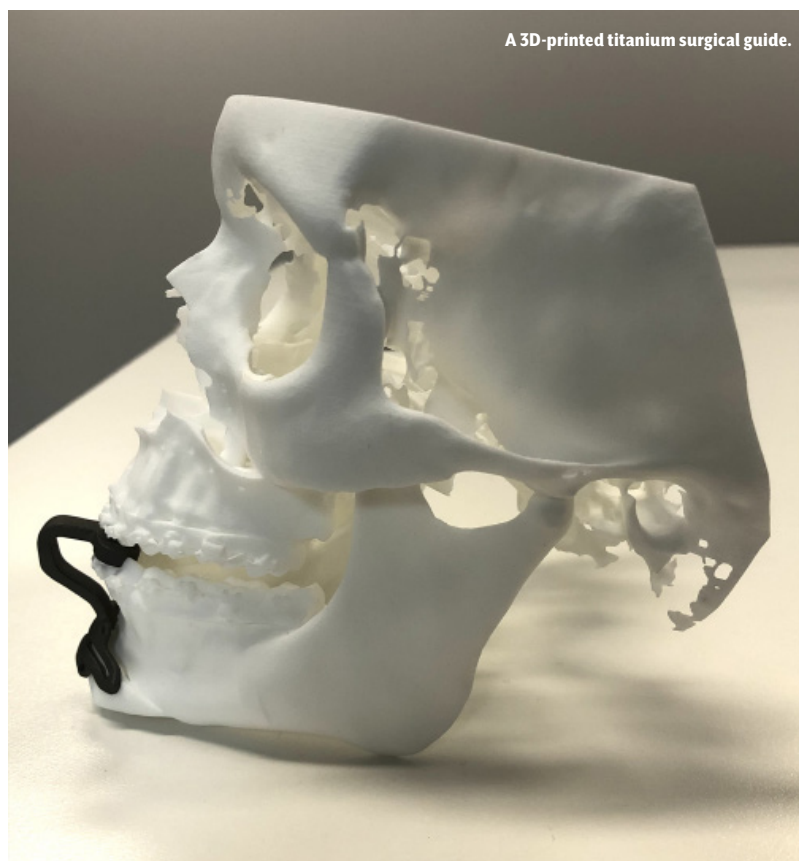
Innovation and technology are two of Air Liquide’s major strengths that have always enabled the Group to play a pioneering role. Today, these

assets make it possible for the Group to contribute to the development of five key sectors of the future (Hydrogen mobility, electronics, healthcare, industrial merchant and high technologies) where it intends to strengthen its positions through the ADVANCE plan.

4. Act for all

As a civic-minded company, Air Liquide strives to ensure that everything it does is in the interests of its shareholders and, beyond that, of society as a whole. Mindful of the changing world, Air Liquide understands how to act in the public interest, where its contribution can make a difference. The Group is involved in long-term community projects in the countries in which it operates. Through the Air Liquide Foundation, it supports scientific projects and employment programs. In partnership with NGOs, the Group is developing initiatives to increase access to medical oxygen.

Air Liquide spends more than €300 million on innovation every year, with more than 50 per cent dedicated to the energy transition and digital technology. **M**



A 3D-printed titanium surgical guide.