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MESSER
Gases for Life

Gases for Life

The industrial gases magazine

COVER STORY

Bridge to the future of production

PRACTICAL FOCUS

Reliable refrigeration for food deliveries

USING GASES

Supercritical for super oil

GREEN PAGE

Oxygen in, NOx emissions down

Dear Readers,

You have before you the last paper edition of "Gases for Life". Parallel to this, you can already experience our industrial gases magazine online – where you will always find it in future.

We want to accomplish a number of goals by taking this step. Primarily, we want to harness the possibilities of a digital publication to offer you added value. This includes moving images, i.e. videos and animated graphics, additional information that could not be accommodated in the print version, or straightforward interactions such as participation in our competition.

The superior sustainability credentials of a digital publication are also very important to us: in future we can dispense altogether with the manufacture and processing of paper as well as the emissions associated with sending the magazines by post.

The "new Gases for Life magazine" therefore fits very well with our efforts to further improve our overall sustainability. Protecting our environment and conserving natural resources is already a priority in respect of many of our products and applications. In future we will place even more emphasis on this "green aspect" of our industrial gases.

I hope you enjoy reading this issue of "Gases for Life" and look forward to receiving your feedback on the first online edition.

Stefan Messer Owner and CEO of Messer Group GmbH

Our cover photo:
Maren Erven, Research Assistant at the Institute of Steel Construction and Mechanics of Materials at TU (Technical University) Darmstadt

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Cryogenic gases for forest berries and mushrooms

Serbia | Fungo Jug in Leskovac is the country's only company to use a cryogenic process to freeze berries and mushrooms. Messer has installed a 30-cubic-metre liquid nitrogen tank at the factory site and is supplying the necessary cryogenic gas. Fungo Jug mainly processes mushrooms, berries and plums. The fruit comes from the company's own 20-hectare plantation as well as selected suppliers in the region. The company has a storage capacity of 1,000 tonnes and the plant is fitted with modern selection, processing, freezing and packaging equipment. The freezing capacity is up to 40 tonnes of berries and mushrooms a day, half of which is frozen in a tunnel freezer using liquid nitrogen. Fungo Jug exports its products to numerous European countries.

Branka Malidžan, Messer Tehnogas

Hartmut Böse, Managing Director of Messer in Germany, Georg Schöberl, Managing Director of basi Schöberl GmbH & Co. KG, Mayor Stefanie Seiler and Stefan Messer, owner and CEO of Messer Group GmbH, laying the foundation stone in Speyer.

Foundation stone laid for new air separation unit

Germany | On 26 June 2019, the foundation stone was laid for Messer's third air separation unit in Germany. Messer is teaming up with gas producer basi Schöberl and investing around 32 million euros in the unit, which will produce oxygen, nitrogen and argon. Construction work at the SAINT-GOBAIN ISOVER G+H AG site in Speyer has already begun and is expected to be completed in the spring of 2020. Messer has been making daily trailer deliveries of gases to ISOVER since May 2019. These gas deliveries and their associated carbon footprint will be minimised thanks to the new air separation unit at the factory site. It is intended that the unit will have a daily production capacity of around 500 tonnes of industrial gases. Some of this output will be used in ISOVER's glass wool production and some of it will be supplied to other customers in the region.

Lisa-Marie Fierus, Messer Industriegase

Real victory in virtual welding

Hungary | High-quality ventilation systems for hotels, shopping centres and industrial firms are produced at Weger in Hungary, where Messer supplies liquid nitrogen for laser cutting and argon for welding. The company has its headquarters in Southern Tyrol and a production facility in Jászárokszállás, Hungary. Works manager Béla Major won Messer's virtual welding competition last May, receiving a high-quality welding mask as the winner's prize. The competition was conducted at MachTech, Hungary's leading welding fair, using a welding simulator. The task was to "work on" a plastic workpiece with a welding torch that is true to the original. The welder follows the formation of the simulated weld through Virtual Reality goggles. Every important aspect of the welding process is realistically simulated without consuming welding materials. At the same time, the practical training period is greatly reduced.

Lilla Németh, Messer Hungarogáz

Reliable refrigeration for food deliveries

People are ordering food on the Internet, with fresh deliveries of convenience products being made every few hours. However, diesel vehicles are increasingly being banned from city centres. Low-emission transport refrigeration therefore needs cryogenic gases.

More and more online providers are delivering packaged meals directly to the consumer. The product range in the refrigerated sections of supermarkets, petrol station shops and station kiosks is also changing, with an ever-growing variety of convenience products such as wraps, salads and portioned meals. The use-by date is being replaced by the use-by hour.

Diesels and noisy vehicles not welcome!

Food logistics has to respond. It is increasingly characterised by smaller units combined with greater speed and flexibility. But no matter what the transport side of things looks like, the cold chain must never be broken! Meanwhile, cities such as Paris, Madrid and Barcelona are restricting access for (refrigerated) diesel vehicles. Other places have banned noisy diesel-powered cooling units from residential areas. However, it is possible to harness the large reservoir of cooling offered by liquid gases without generating any noise or exhaust gases. Moreover, their cooling capacity can be regulated very precisely. Messer has developed a number of efficient and low-emission transport refrigeration systems of varying sizes.

Small transport boxes filled with dry ice snow

The combination of SnowDrop (Messer) and MiniCryo (Olivo) is ideal for ensuring that individual deliveries reach the end customer well cooled. The SnowDrop station produces dry ice snow from liquid CO_2. It automatically conveys the cooling medium – with a temperature of minus 78 degrees Celsius – into a specially designed compartment in the lid of the MiniCryo transport box supplied by Olivo, a leading manufacturer of refrigerated containers. This charge ensures that the cold chain temperature is maintained for up to 16 hours. The equipment can be used for both chilled and frozen products. The box is optimally insulated and very lightweight, making it perfectly suitable for manual handling.

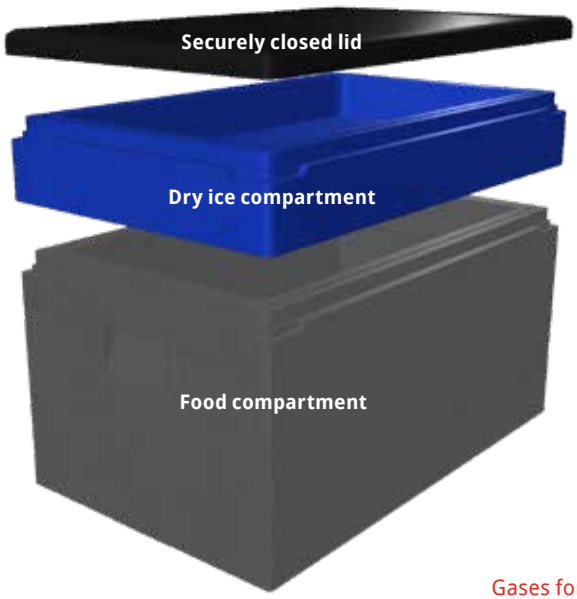
The Cryo2Pack system for all kinds of portable cooling boxes also facilitates the creation of your own cooling elements within a matter of seconds. This involves special plastic bags being filled with dry ice snow.

Insulated containers and trucks

Next up in size is the Siber system, which Messer also developed in cooperation with Olivo. It comprises insulated containers on wheels and a filling station. Again, the low temperatures are generated by a dry ice filling. The high-pressure liquid carbon dioxide is pumped directly into the refrigerated container's reservoir, where it expands and partly turns into dry ice. The containers can be used to transport chilled as well as frozen products. The cooling effect is designed to last at least 24 hours.

Cooling with a gas also has enormous advantages when it comes to the large load compartments of trucks. In this case, the noisy cooling unit is replaced by liquid nitrogen. Messer's EcoLIN system supplies the cooling gas from a nitrogen tank to the truck's load compartment via a special heat exchanger. Temperature fluctuations caused by the doors being opened are evened out with minimal delay. In comparison to conventional refrigerated trucks, CO_2 emissions can be significantly reduced. A similar system for the refrigeration of small trucks and vans with dry ice snow is currently being developed at Messer. For both systems, Messer is cooperating with its partner Frappa.

Editorial Team



Simplified diagram of the MiniCryo box

Doubling of nitrogen capacity

Austria | Wieland Austria uses nitrogen and hydrogen supplied by Messer in the production of copper tubes. The tubes are annealed in an atmosphere consisting of a mixture of both gases. The nitrogen is obtained from air by means of a generator at the company's Amstetten site, with any additional nitrogen requirements being met by Messer road tanker deliveries. Wieland intends to install an additional annealing furnace in 2020. To meet the increased nitrogen requirements, a generator with double the capacity will be installed to replace the existing one.

Uwe Rosenow, Messer Austria

Liquid gases for electric powertrain production

Serbia | Messer supplies carbon dioxide and nitrogen in liquid form to the new ZF site in Pancevo. The ZF technology group is a major supplier to the automotive industry and also has operations in the rail and shipbuilding sectors. The company's headquarters are in Friedrichshafen and it has a presence in 40 countries worldwide. The new plant in Serbia produces electric motors for hybrid and electric vehicles. The gases are needed for inertisation of the system and testing of assemblies.

Branka Malidžan, Messer Tehnogas

Specialty gases for animal feed analysis

Spain | Messer has supported animal feed producer Al Dahra Europe during the planning and installation of a gas supply system for its new laboratory in the Catalan province of Lleida. Messer also supplies the lab with specialty gases such as argon, synthetic air, helium, nitrogen and hydrogen for quality control. One of the techniques the laboratory uses for this is ICP spectroscopy, which involves the use of high-purity argon with 300-bar-technology. This technology allows the customer to reduce cylinder rotation. Al Dahra has its headquarters in Abu Dhabi and is one of the industry's leading global suppliers. The company has five production facilities in Spain, which predominantly produce bales of dehydrated, high-density alfalfa as well as alfalfa pellets. About 90 per cent of these products are exported, mainly to the United Arab Emirates.

Maria Elena Catarineu and Marion Riedel, Messer Ibérica

Jens Leichthammer

Jens Leichthammer has worked as Group Legal Counsel at Messer since 2013 and is based in the Corporate Office in Bad Soden. He has also held the newly created position of Group Privacy Officer with responsibility for data protection since 2018.

What has been your nicest "gases experience"?
Working with people from different countries within the scope of Messer Academy and implementing Messer projects together. I am very proud that we managed to do this as a team.

What would you say is a must-see for anyone visiting your country?
There are many beautiful places you can visit in Germany, some of which are underrated. I would therefore find it very hard to pick out a particular destination. My advice would be to explore the regional attractions of the area you happen to be staying in. You will be surprised at how many open and friendly people you'll meet.

What three things would you miss least?
Disease, injustice and people with negative energy.

What else would you like to learn or study?
Outside of work, languages are near the top of my list. I'd also like to be able to play the guitar really well.

Which famous person would you like to spend an evening with?
I would have liked to have spent an evening with the late Apple founder Steve Jobs. He had to deal with a lot of setbacks in his career, yet he always picked himself up and carried on. He never feared change and always called existing business models into question.

In the legal department, you have to deal with the changes brought about by digitalisation. What do they mean for your everyday life?
The subject of digitalisation has gained enormously in importance over the past few years. As a result, we now also have a lot of legal tech tools, software and other digital solutions. However, as an initial step, you need to have a clear identification and definition of tasks. One should first analyse the existing processes to determine which ones are worth digitalising. Because if you digitalise a useless process, you just end up with a useless digital process. It is therefore advisable to begin by defining the processes and identifying the optimisation potential. For instance, electronic records have made the legal department's work noticeably easier.

Can you tell us about your change strategy?
The digitalisation and optimisation of work processes can only be implemented gradually. Moreover, a sensible departmental digitalisation strategy should be integrated into the company's overall strategy. Because what goes for the company as a whole – i.e. delivering the best possible result to the customer – should also go for the legal department and its internal clients.

What role does communication play here?
I believe it is essential to communicate and share information with other departments. This is the only way to reduce the risk of developing solutions in isolation from one another only to discover in the end that an equivalent process or tool already exists within the company.

How will digitalisation affect existing processes?
First and foremost, digitalisation and the use of new tools is also a change management process. Staff should therefore be included at an early stage and encouraged to participate in the new processes. People are more likely to accept change if they can see how they will benefit from it.

What is your connection with change management?
I'm a bit of a technophile. I also provide legal support to Messer Information Services, Messer's IT company, giving me very good access to this sphere. But the key thing is wanting to engage with the topic, having the right mindset and not being afraid of change. I am driven by curiosity more than anything else, in the sense of a deep interest in new things as well as digitalisation.

Bridge to the future of production

Not that long ago, 3D printing still had a definite futuristic air about it. Today, it has already become standard in some areas and is even possible with metallic materials. As is so often the case, (almost) nothing is possible without gases.

A world premiere took place in Darmstadt last autumn. For the first time ever, a steel bridge was constructed in the open air using 3D printing. Admittedly, the watercourse that had to be bridged wasn't exactly the Amazon – just an artificial stream in the grounds of the University of Technology. And the three-metre span meant that the bridge was of a fairly manageable scale.

But in addition to the first ever such construction anywhere, the bridge also demonstrated the success of a new process. While virtually all 3D processes involve a vertical operation from bottom to top, here the material was also added horizontally, i.e. from the side. "Only thanks to this fact were we able to complete the entire construction on site," project manager Thilo Feucht, a research assistant in the field of steel construction, explains: "The new method gives us additional construction options, including for considerably larger structures."

Metal drops as basic material

The beginnings of 3D printing – also known as additive manufacturing in technical jargon – go back to the 1980s. Initially the process was limited to plastics and primarily used to make prototypes and moulds. However, since the beginning of this century, it has increasingly been used in mass production. In recent years, its use has also been extended to metallic materials. It has since become a standard production process in more and more sectors and fields of application.

Metals are processed in the form of powder or wire in 3D printing. While the wire is usually the equivalent of conventional welding rods, producing the powders is more involved and requires the use of special methods. In most cases, this involves molten metal being injected through a nozzle and transformed into fine droplets. "The spherical form of the particles ensures a free-flowing powder," Dr Dirk Kampffmeyer, a welding and additive manufacturing expert at Messer, explains. "In many processes, this is a crucial prerequisite for effective processing of the powder." To prevent oxidation of the hot metal, it is pushed through the nozzle by an inert gas – usually argon – at high pressure.

Continued on page 12

Powder bed, spraying and wire feed

The finished powder enters the powder bed, a container with a bottom able to be lowered. The powder is introduced in layers. A computer-controlled laser or electron beam heats the powder at specific points. This triggers a kind of sintering process, whereby the powder is turned into a solid form. When a layer is finished, the bottom is lowered by the thickness of a layer. New powder is then applied, and the next layer is sintered onto the one below it. Workpieces are thus produced layer by layer. Powder bed processes can achieve high levels of accuracy, often making rework unnecessary. The main limitation concerns the dimensions of powder beds, with the largest ones measuring 80 by 40 centimetres. Powder spraying is not affected by this limitation. With this technique, the metal powder is sprayed through a nozzle into a laser beam – again argon is the main gas used. Melted by the laser, the powder is deposited on a base as a "bead". This technique is generally used in conjunction with a tilt & turn table. The component is given its specific form by tilting and turning the base underneath the fixed nozzle.

Instead of using a powder, another possibility is to feed a wire into the laser beam. Wire is much more straightforward and less expensive to produce than metal powder. The latest developments feature a coaxial wire feed mechanism that facilitates directional independence, just like with powder spraying. This involves a split laser beam being merged again in the melting zone. The use of wire can make additive manufacturing cost-effective even for components well below the high-end price segments.

Quality and welding know-how

The latter applies all the more to Wire Arc Additive Manufacturing (WAAM). In principle this process corresponds to the

Juliane Keppler, working student at TU Darmstadt, monitoring the 3D printing process via a control panel.

tried and tested MIG/MAG welding method. Instead of putting down a single weld, the welding robot proceeds on a bead-by-bead, layer-by-layer basis to produce a three-dimensional object. This process was also used by the bridge-builders in Darmstadt. According to Thilo Feucht, their raw material was a "common-or-garden welding wire" no different from common structural steel. Incidentally, the trick to adding liquid metal from the side without it dripping down is to time the phases correctly: "The material has to cool down before new metal is added. We therefore assembled the entire bridge from individual weld spots at one-second intervals."

Almost all welding and sintering processes have one thing in common: they can only achieve the required quality in an inert gas atmosphere. "This is where our specific know-how comes into play," Dr Bernd Hildebrandt, head of the welding and cutting application area, emphasizes. "We have a good understanding of the interaction of the various metals and alloys on the one hand and the gases and gas mixtures on the other. The desired result can only be achieved if both are combined in the optimal way. Here we can provide comprehensive advice to our customers."

To ensure that we always do this on the basis of state-of-the-art technology, Messer is also a network member of the Aachen Centre for Additive Manufacturing, along with some of the biggest car manufacturers and automotive component suppliers as well as other technology leaders in metal 3D printing. Furthermore, Messer takes part in the Formnext trade fair every year, where additive manufacturing experts from all over the world meet. Dr Kampffmeyer: "Additive manufacturing complements conventional metalworking processes and will replace some of them. As gas experts, we are at the forefront of this development."

Editorial Team

3D printing of components involves the use of various gases – shielding gases, carrier gases and cooling gases – at different stages of the production chain.

Shielding gas for overhanging structures

Interview with Maren Erven, Christopher Borg Costanzi and Thilo Feucht, Steel Construction Department, Technische Universität Darmstadt

What was the biggest challenge you faced when building the bridge?
M.E.: The most important thing was to keep deformation of the material after it cooled down under control. The degree of deformation was considerably greater than first assumed.

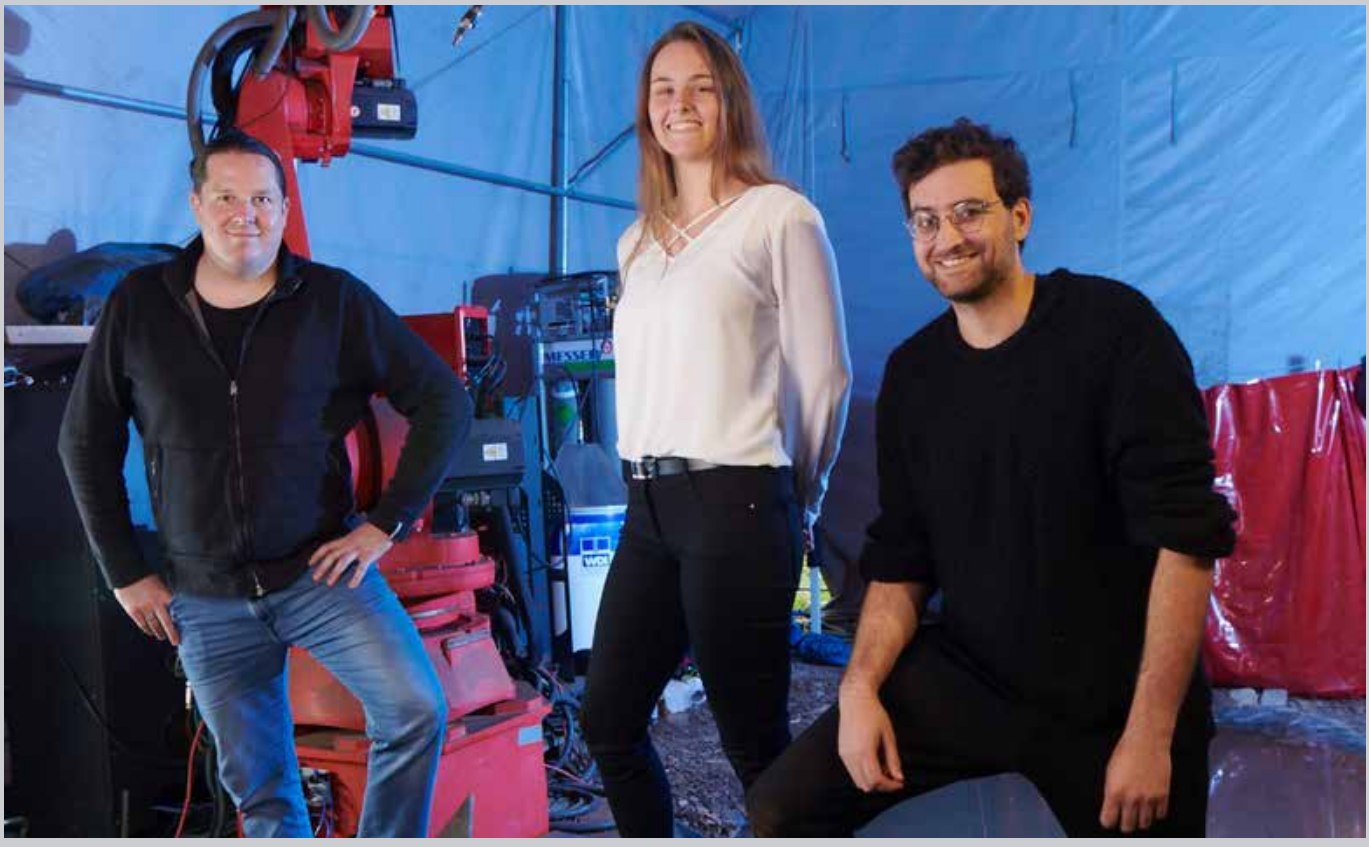
How did you resolve it?
C.B.C.: Initially, we had got the robot to weld along the entire cross section of the bridge. In order to minimise the distortion, we had a narrow section made in the middle, with a further two strips then being attached to the left and right of it.

Why did you choose Wire Arc Additive Manufacturing (WAAM)?
T.F.: Because, compared to other additive processes, it's quick, economical and location-independent.

How do you see the future of WAAM?
M.E.: We believe it opens up a wealth of new possibilities in the building and construction industry. You can attach virtually any shape to existing parts. There is no need to cut parts to size and hold them in place during the attachment process. This can save a lot of time and expense, particularly with smaller or special applications as well as complex shapes.

What role did the welding gas play?
C.B.C.: The gas influences the width and height of the weld. Messer's mixture ensures a very flat and wide weld, which is attached from the side, making it very good for overhanging structures.
T.F.: We needed large quantities of the gas in the course of building the bridge, and Messer provided us with it free of charge. We are very grateful for that.

AM Bridge Project
The Steel Construction Department at Technische Universität Darmstadt completed its AM Bridge Project in November 2019. AM stands for Additive Manufacturing. The 3D printing of a cantilever bridge on site was a world first.



From left to right: Thilo Feucht, Maren Erven und Christopher Borg Costanzi

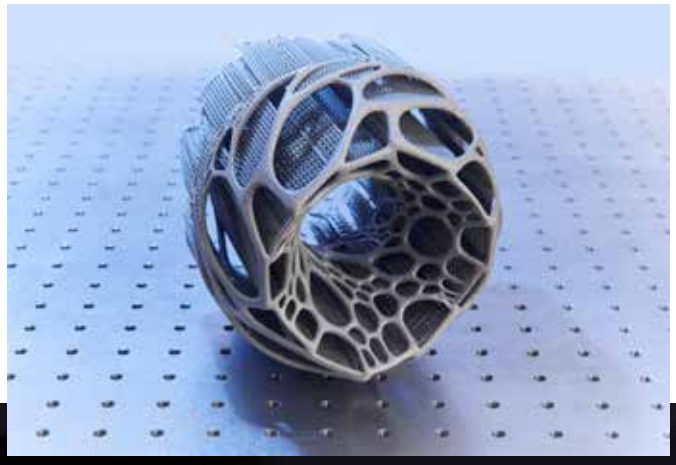
3D printing with metal – the most important processes

Powder bed (L-PBF / EBM)
The metal powder is sintered in layers with a laser or electron beam. Any geometry is possible, plus the process is very accurate, with little or no rework required. The disadvantages are limited object size (max. approx. 50x50 cm) and the relatively slow and cost-intensive printing process.

LMD with wire feed (LMD Wire)
With this method, the wire is fed into a split laser beam and melted by it. The process is similar to powder spray and correspondingly economical.

Powder spray (LMD Powder)
Here metal powder is sprayed into a laser beam and melted in it. Compared with the powder bed, this process is quicker and more economical, but less precise. Larger objects can be printed, but with limitations in terms of geometry.

Wire Arc Additive Manufacturing (WAAM)
In principle, Wire Arc Additive Manufacturing corresponds to the MIG/MAG welding process. It is suitable for large objects, with lower precision, but rework may be required. The process is economical and quick.



3D component from a powder bed

Binder jetting (left: green body, right: finished component)

Dry ice for Moravian wine

View into the cockpit of the self-constructed racing car.

Messer supports student racing team

Slovenia | Messer is supporting the University of Ljubljana's Formula Student Team with gases and welding know-how. Formula Student is a competition in which student teams from around the world compete against each other in self-constructed racing cars. In this race series, it is not just the results of the actual races that matter. Points are also awarded for technical aspects such as vehicle production and costs as well as design, durability and efficiency. Formula Student is the largest international competition for mechanical and electrical engineering students. Races are held in three different categories – combustion engine, autonomous and electric.

Edvard Bjelajac, Messer Slovenija

Czech Republic | The Kolby wine-growing estate in Pouzdřany, southern Moravia, uses dry ice to cool its grapes immediately after harvesting and thus ensure the right conditions for the proper maceration of the mash and draining of the wine must. Messer has installed a liquid CO_2 storage tank as well as a pelletizer for dry ice production at the estate and also supplies the carbon dioxide. Kolby combines traditional and modern wine-making methods: the grapes are harvested by hand and carefully pressed. The first step is maceration of the must, which is followed by controlled fermentation and careful filtering. The estate's vines grow on the south-facing slopes of this prominent location, which goes by the same name.

Jiří Svatoš, Messer Technogas

Quick cleaning with dry ice

Switzerland | It now only takes 15 minutes rather than three hours to clean the workpiece carriers on a production line at Festo Microtechnology in Pieterlen. This speeding up of the process was achieved through integrated dry ice blasting. Previously, the workpiece carriers had to be removed from the valve component production unit, washed by hand in the small component cleaning unit and then installed again. Now they are cleaned with dry ice directly on the line. This process also uses the new P75i dry ice pelletizer recently launched by ASCO. ASCO and Festo developed the permanently integrated cleaning stage in collaboration with the manufacturer of the production line. The only manual effort required now is to connect the ASCOJET dry ice blasting unit and fill it with dry ice pellets. All oil residues are automatically cleaned off the workpiece carriers in three runs. The result is a complete and even cleaning process that neither leaves any residue nor requires the disposal of detergents.

David Oehler, ASCO CARBON DIOXIDE

Photo: Cibdol AG

Supercritical for super oil

Cannabidiol is a legal and drug-free hemp product with interesting properties. The best way to obtain this fine oil is through supercritical extraction with carbon dioxide.

Cannabidiol (CBD), one of the cannabinoids, is an active substance that is obtained as CBD oil from the leaves and flowers of the hemp plant. Unlike other products derived from this raw material, it is not psychoactive. But people do attribute some very positive properties to it, claiming that it has a "relaxing, anti-inflammatory, anxiety-reducing and nausea-inhibiting" effect. As a potential natural remedy and food supplement, it is subject to approval restrictions that are not applied uniformly within Europe.

Positive experience with CBD

However, there are no restrictions on its use for cosmetic purposes. Swiss company Cibdol mixes it into skin creams, which it promotes as having particularly nourishing and protective properties. "There has been a veritable CBD craze for about five years, evidently because more and more people are very satisfied with the oil," operations manager Liebe Griebenauw explains. "Last year saw an increase in demand for synthetic CBD, particularly in cosmetcis."

Cibdol extracts it from the hemp plant, with the dried leaves and flowers of authorised industrial hemp varieties of the species Cannabis sativa serving as the raw material. These plants are grown in Swiss fields. In contrast to the marijuana species Cannabis indica, these hemp varieties contain only minimal traces of the psychoactive substance THC, which acts as a drug.

Gentle separation

The resin of the legal hemp plant only contains relatively small amounts of CBD, which is extracted with the hemp oil. A common extraction method involves the use of special solvents. However, an even more effective way of extracting it is to use supercritical carbon dioxide. Messer supplies the gas for this process to Arbolea, a company for research and development in the fields of natural sciences, engineering sciences, agricultural sciences and medicine. In its supercritical state, CO_2 is highly compressed and possesses enormous dissolving capacity for organic substances.

Supercritical fluids have the density of a liquid and the flow properties of a gas. Their dissolving capacity increases rapidly in the transition to this state. The gas reaches its critical point at just 31 degrees Celsius and a pressure of 74 bar. The ground hemp flowers therefore have to be heated to just above room temperature in a pressure vessel in order to extract the flower oil. Supercritical fluid extraction (SFE) facilitates precise and gentle separation of substances.

Finest quality

This ensures that the quality of the fine oil remains unimpaired. Moreover, carbon dioxide is inert and completely non-toxic. It simply vaporises after the extraction process and can then be reused as a solvent in a closed circuit.

A small proportion of THC in the unprocessed oil cannot be avoided even when using industrial hemp. However, Arbolea and Cibdol claim to remove it so thoroughly themselves that it can no longer be detected afterwards. This is done using a chromatographic method which the Swiss companies keep a closely guarded secret. "The end product is a golden oil with a CBD content of around 70 per cent," Sean Wassermann, who is in charge of extraction and refining at the Swiss company Arbolea, explains. "The rest consists of desired substances such as fatty acids, carotenoids and terpenes. Supercritical extraction is a key factor in ensuring high product quality."

Editorial Team

Nitrogen and helium for cutting-edge research

Synchrotron light allows the tiniest details of matter to be investigated on the atomic and molecular level, paving the way for scientific advances, including in biomedicine, materials science and archaeology. The ALBA Sincrotrón science facility uses helium cooling in a range of equipment and apparatus.

Scientists from Salamanca and Amsterdam have found out how molecules at the boundary between the upper and lower layers of the human skin are connected to one another. A group of researchers from Barcelona and Belgium's KU Leuven University have taken a major step in developing a new material for more efficient solar cells. It has also been possible to carry out a very detailed non-destructive examination of the chemical composition of medieval human bones discovered in a church in Herzegovina.

Millions of times brighter than the sun

All of the aforementioned experiments – and the list of projects could go on and on – were carried out thanks to the synchrotron light generated by the ALBA Sincrotrón electron accelerator complex in Cerdanyola del Vallès near Barcelona, the only synchrotron light source in Spain. This science facility has eight laboratories which allow a wide variety of scientific fields and problems to be investigated. The spectrum ranges from infrared to high-energy X-rays. One of the biggest advantages is the extreme brightness of synchrotron light, which is millions of times brighter than the surface of the sun. This level of intensity allows extremely high resolution and facilitates observation of very short-lived phenomena such as chemical reactions.

ALBA Sincrotrón is the most complex science facility in Spain. Standing out among the different elements essential for its operation are the superconducting magnets that are used in one of the facility's light lines (BOREAS, to investigate the magnetic properties of materials) as well as in one of the loaders for storage rings. For these magnets to work properly, they have to be cooled with liquid helium at a temperature approaching minus 270 degrees Celsius.
Although helium is the second most common element in the universe, there are limited reserves of it on earth. Obtaining it – mainly from certain gas fields – is a laborious and expensive business.

Saving energy through helium recycling

Since some of the gas evaporates during the process of cooling the magnets, ALBA teamed up with the Catalan Institute of Nanoscience and Nanotechnology (ICN2) to install a facility that liquefies the gaseous helium again. This allows up to 80 per cent of the gas to be recovered. This in turn significantly reduces both the operating costs and the environmental impact. ALBA's helium recovery facility has an annual recycling capacity of 25,000 litres of liquid helium.

However, liquefying helium is a particularly challenging task due to the element's properties: it only cools down like other gases during expansion at atmospheric pressure below minus 233 degrees Celsius. Helium therefore has to be precooled to below this temperature before it can be liquefied using the usual cycles of compression and expansion. Cryogenic liquid nitrogen is used for the precooling process.

Messer replaced the previous gas supplier in 2019 after winning a tender. Since the synchrotrons operate around the clock, it was essential that there was no disruption of supply during the transition phase. During installation of the new nitrogen cryotank, a temporary supply was put in place which included a cryogenic vessel with a capacity of 16 tonnes, a cryogenic hose and the necessary special valves. The tank change was completed as planned and the scientists were able to continue their experiments without interruption.

Marcos Torcal and Marion Riedel, Messer Ibérica de Gases

Aerial photograph of the ALBA Sincrotrón complex

Fish love oxygen to go

Czech Republic | The Blatenská Ryba fish farm in Blatná, southern Bohemia, uses oxygen to create ideal conditions for its fish during live transport. Mounted on the truck is a 200-litre tank from which the gas is continuously fed into the water in the transport tanks. The oxygen is regularly replenished from a large stationary tank at the company's facility. Messer installed this tank and supplies the gas. Blatenská Ryba also uses it in a modern recirculating aquaculture system for carp farming. Apart from fish farming, the company is also active in fish processing and the manufacture of fish farming equipment.

David Bek, Messer Technogas

Shielding gas for trawl doors

France | Saint-Malo based metal processor Morgère has been producing components for the fishing industry since 1902 and is one of the world's leading suppliers of trawl doors. These contoured flat steel constructions are attached to the openings of trawl nets and keep the nets open during fishing. Morgère uses Messer's triple saver mixture Ferroline C12X2 to weld the trawl doors, having successfully tested it at the factory. The mixture consists of argon, CO_2 and oxygen. Its use speeds up the welding process, reduces spatter and produces a smoother weld and better overall welding quality. The amount of rework required is also significantly reduced.

Caroline Blauvac and Arnaud Menec, Messer France

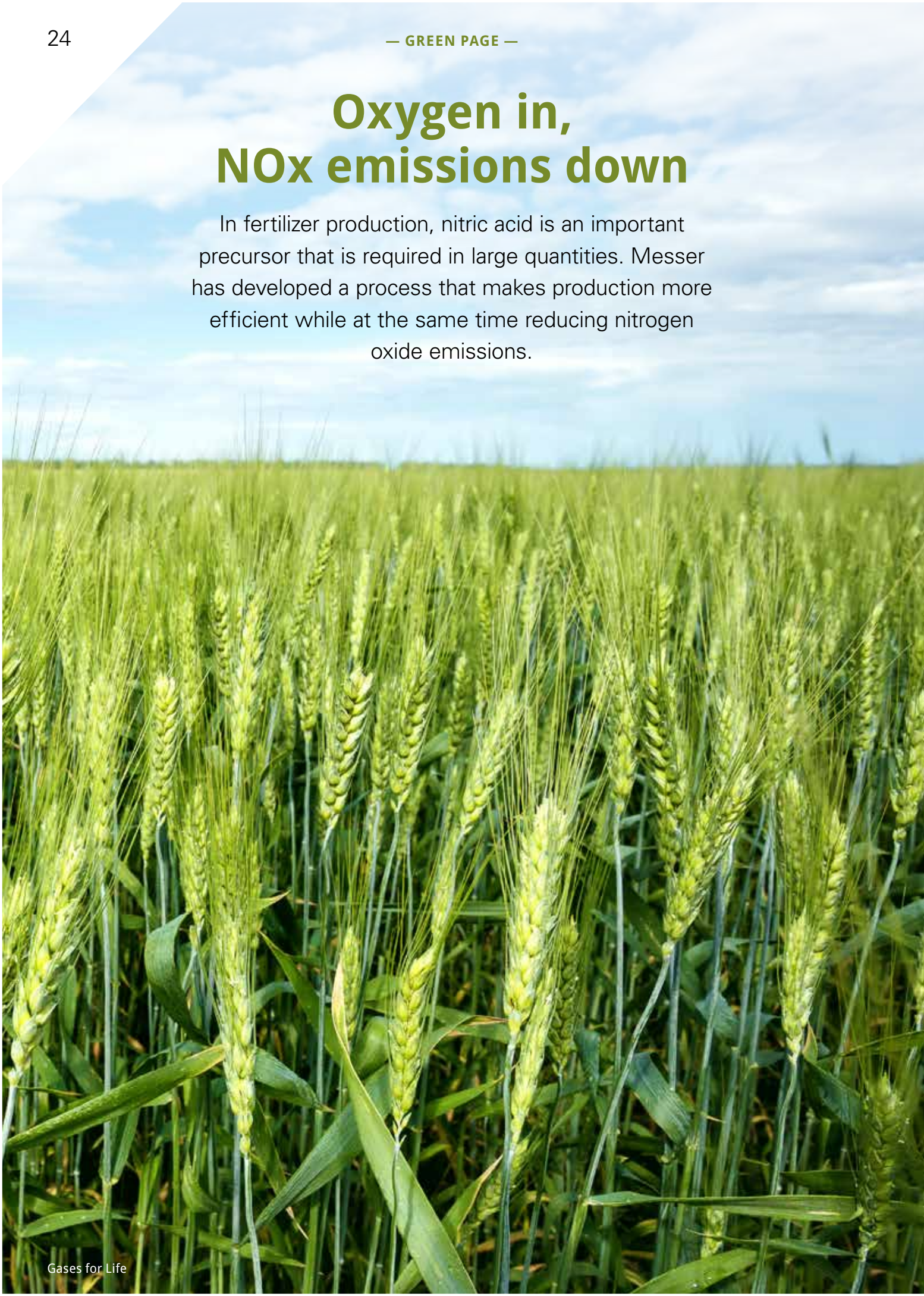
Massive investment in Indianapolis

USA | Messer is investing over 34 million euros (38 million US Dollars) to construct a new air separation plant in Indianapolis, Indiana. The production plant for the air gases oxygen, nitrogen and argon is scheduled to go into operation in early 2021. It will produce industrial and medical grade gases for various sectors of the local and regional economy, including the healthcare, chemical, food, glass and metal industries. It will further strengthen Messer's presence in the Midwest. "This investment underscores Messer's commitment to strategic expansion in the US to meet growing market demand," said Jens Lühring, President and CEO of Messer Americas. "We chose to invest in Indianapolis due to its strong pro-business climate and optimal proximity to customers."

Gina Gibbs Foster, Messer Americas

Oxygen in, NOx emissions down

In fertilizer production, nitric acid is an important precursor that is required in large quantities. Messer has developed a process that makes production more efficient while at the same time reducing nitrogen oxide emissions.



Some 60 million tonnes of nitric acid (HNO_3) are needed annually worldwide, 80 per cent of it in the fertilizer industry. Its production requires (atmospheric) oxygen, ammonia and water. These raw materials are transformed into the desired end product in a complex series of reactions. The fundamental process was developed by German chemist Wilhelm Ostwald back in 1902.

Simple vs. complex

The intermediate products include nitrogen oxides. These need to be reduced as much as possible since nitrogen oxide (NOx) emissions are subject to strict environmental regulations. Aspects of the nitric acid production process have been improved in detail over the years and facilities optimised accordingly. The main focus of these efforts has been on energy efficiency and reducing emissions. However, technical optimisation of facilities is a complex and cost-intensive process.

Messer has developed a system that facilitates considerable efficiency gains and reduces NOx emissions – without a large amount of technical complexity. "We achieve these objectives through the introduction of pure oxygen," Dr Nina van Gellecom, Chemical Applications Expert at Messer, explains. "Certain reaction steps such as the oxidation of nitrous acid and dinitrogen tetroxide are significantly intensified with a much better end result. The crucial thing is to inject the gas at specific points in the process in accordance with a method developed and patented by Messer."

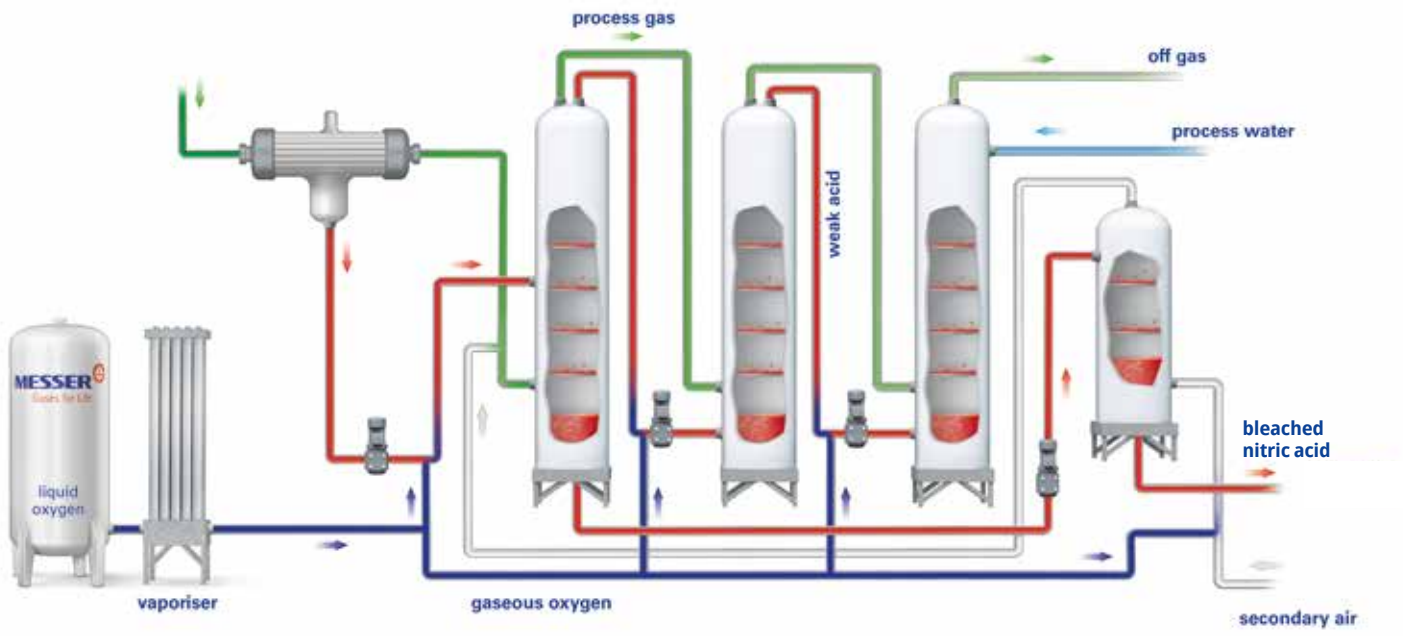
Small investment, great benefit

The investment required is very manageable, particularly in relation to the return. This is demonstrated by the example of Azomures in Romania. The chemical company operates a plant in Tîrgu Mureş, which came into being back in the 1960s. Production efficiency was lower than that required by present-day standards, resulting in the release of excessive amounts of nitrogen oxides. In order to keep these emissions within the limits, the plant regularly had to be operated at reduced capacity or shut down altogether over longer periods in the warm summer months.

With the oxygen injection system installed by Messer, NOx emissions were reduced from 220 ppm to 20 ppm (ppm = parts per million) during testing. The emission limit within the EU is generally 90 ppm. Absorption of the nitrous oxides in the DeNOx unit – where some of these gases are converted to harmless nitrogen – was significantly improved. The supply of ammonia, which is required for reduction, decreased by 50 kilograms per hour at this point. At the same time, output increased by 260 kilograms per hour. This gain has been further increased through longer uptimes: since the plant now complies with the strict EU regulations on NOx emissions in warm weather as well, it can operate at full capacity during the summer months.

Editorial Team

Oxygen injection Process



Precise flow regulation

Simon Schaeffer, production manager at **Bürkert Fluid Control Systems**

How would you describe your line of business?
The Bürkert family business is one of the leading suppliers of fluid measurement and control systems, including mass flow controllers for gases. We are the only company that can offer the whole product range from a single source. At our System-haus locations, we develop turnkey application-specific systems to meet our customers' requirements.

Where are mass flow controllers (MFCs) needed?
Flow control is essential in most process engineering operations. It is a key contributor to the efficiency, reliability, quality and safety of the processes. MFCs for gases, for example, are needed in fermenters, in surface treatment, glass-making, laser cutting, the food and beverage industry as well as medical devices.

What role does the calibration of MFCs for gases play?
As automated control depends on the results of measurements, calibrating the MFCs with the operating gas is key to achieving precise, reproducible results. This is the only way to optimise product quality and process costs. The argon-krypton filling for double glazing, for example, has to be added in a very precisely controlled way.

Which gases do you use?
We use approximately 40 different calibration gases, some of them in pure form such as argon, helium or methane, others in a wide variety of mixtures. We keep 150 gas cylinders in stock for this purpose.

Why did you choose Messer?
In 2008, our MFC production moved from Germany to Triembach-au-Val in Alsace, France. We needed new suppliers. Messer responded quickly and efficiently to our complex inquiry and soon became a trusted partner.

What expectations do you have of your gas supplier?
We expect a lot because our customers also expect a lot of us. The gas supplier has to understand our needs and be able to respond quickly. This applies equally to special mixtures, delivery times, technical support and training in the safe use of gases. Messer is a company that takes the initiative and ensures that we can plan efficiently.

Caroline Blauvac and Jean Baudu, Messer France

Win a delicious prize

Simply answer our question about this issue of "Gases for Life" and win a food hamper with seasonal specialities:

What does the abbreviation WAAM stand for?

Please send the correct answer by e-mail with the subject line "Gases for Life Competition" to:
angela.giesen@messergroup.com
The deadline is 28 Feburary 2020. Please include your name and address. The competition is unfortunately not open to employees of the companies of the Messer Group and their families. In the event of multiple correct answers, a draw will determine the winner. The result of the draw is final and not subject to appeal. By registering to take part in this competition, you consent to your name (first name, surname) as well as your place of residence (town, country) being published in the next issue of Gases for Life, should you win. The participant is responsible for the accuracy of the information provided. No liability is assumed in connection with the publication of the name.

Congratulations!

The winner of the competition in issue 28 is **Ian Pogonowski** from **Blackwater, United Kingdom.** The correct answer was: "70"

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Welding gases for heavy equipment

Heavy machinery manufacturer Caterpillar uses argon and carbon dioxide from Messer to weld excavator shovels, loaders and other earth-moving components at its factory in Gödöllö, Hungary. The gases are supplied in liquid form and mixed at Caterpillar. A mixture of 82 per cent argon and 18 per cent CO_2 is used for manual MAG welding; robot welding involves the use of a reduced quantity of active gas. Messer also supports the customer by providing application-specific advice and by carrying out system audits and inspections of welding equipment. Incidentally, the company name goes back to a real innovation which enabled Caterpillar founder Benjamin Holt to improve the traction of his agricultural machinery at the beginning of the 20th century. He replaced the tractor wheels with a combination of chains and blocks of wood. An observer of the first successful tests was impressed by the "caterpillar-like movement" of the implement. Holt seized on the idea and named his company Caterpillar.

Find out more!
"Gases for Life" will be published as an online magazine in future – with interesting multimedia features.
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