Green energy for the future of the blue planet

The hanging

An industrial operation where the only waste product is oxygen? It sounds far-fetched, but it is already a reality: At eparella GmbH, a subsidiary of ecoduna AG, production is based on nature's recipe. At the eparella plant in Lower Austria, this approach is being used to produce microalgae – on an industrial scale. And compressed air – of the highest quality standard – is an indispensable part of the process.

Photo: ecoduna

gardens of ecoduna

Microscopic – but highly versatile

The future potential of the market for microalgae is enormous – as demonstrated by the billions in sales already generated today through worldwide demand for this valuable raw material. Most demand comes from growth markets, for example the food and food supplement industries, cosmetics and pharmaceuticals, which benefit from the high concentrations of high-quality omega-3 fatty acids contained in microalgae. ecoduna is working to establish itself as an important player in this market, which the company believes will be adversely affected by a decrease in the supply of fish oil-based omega-3 fatty acids in the future.
Other high-potential ingredients for which microalgae serve as a raw material include pigments, antioxidants, carbohydrates and proteins. At present, most of the worldwide output of microalgae, totalling 90,000 tonnes per year, is produced in East Asia, Australia and North America, with European producers still accounting for a relatively small share of global needs. That represents a big opportunity for ecoduna, especially considering that Asian microalgae often fall short of European standards and are therefore of limited use in the food industry.

Patented technology

In the Lower Austrian city of Bruck an der Leitha, eparella opened an advanced production facility for high-quality microalgae in March 2018. The company has built one of the world's largest production plants, with a total area of over 10,000 m². When fully expanded (planned for 2021), it will generate approximately 300 tonnes of biomass annually.
The key ingredient to success is a patented technology for the resource-conserving production of high-quality algae powder. And as mentioned above, the only waste product is oxygen. This patented ecoduna technology sets the company apart from its competitors: The microalgae are cultivated in a highly sterile environment using vertical glass tubes in a closed system.

This provides the operator with maximum clarity regarding system operating status, with all data available for retrieval at any time.

The main components are 150 metre-long arrays of 6-metre tall, interconnected glass tubes known as photobioreactors. A special geometric configuration makes optimal use of the available light – a vital factor for algae growth – as compared to conventional systems. Also promoting ideal growth conditions is an innovative process for delivering carbon dioxide and nutrients to multiple locations in the system, with sensors monitoring precise adjustments to the individual algae culture. Through the use of the "airlift" principle, the reactor technology can be operated without pumps. Injected air bubbles cause mixing of the medium and clean the glass while transporting carbon dioxide into the system and oxygen out of it. This procedure maximises productivity while greatly extending the useful life of the equipment – and justifies eparella's proud claim to technological leadership.

Turnkey compressed air

It will come as no surprise that this system needs compressed air. Firstly, it is used to transport the algae suspension through the photobioreactor. And secondly, compressed air is needed to control the pneumatic valves, 100 of which are installed in the system to facilitate a high level of automation. It is obvious that KAESER faced stringent demands when supplying a solution for an industry as sensitive as microalgae production. That starts with the reliability of the compressed air supply. Continuous operation must be guaranteed 24 hours a day, 365 days a year, with no interruptions. To meet that high standard, the compressed air system is designed with redundant functions. In that regard, it is worth noting that KAESER was brought on board when the project was still in the planning stages and was able to provide key input on the design of the compressed air system and the layout plan. Another important reason for this early involvement was the fact that the system was implemented as a turnkey project, in other words with the piping, ventilation and electrical systems included. Consequently, eparella opted for a com-

Refrigeration dryers of types TL 1301 and ABT 25, active carbon absorbers, microfine upstream filters, downstream filters for achieving Particulate Class 1 (as per ISO 8573-1) and several other filter devices ensuring the high quality of the compressed air.

The compressed air system for the eparella production facility was implemented as a turnkey project, with the piping, ventilation and electrical systems all included. Consequently, eparella opted for a complete ready-to-run package. All it took to put it into operation was a push of the button to start the compressed air supply.

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Two pressures, two networks

The demanding specifications for the system were not limited to the reliability of the supply, however. Because different pressures apply to the compressed air networks for reactor air and system controls, the set-up basically consists of two stations. The reactor air is generated by two energy-efficient, variable-speed FSD 475 SFC rotary screw compressors rated at 7.5 bar with flow rates between 10.6 and 49.87 m³/min. The two FSD compressors are specifically designed to operate in the low pressure range. The speed control ensures that the compressors can deliver any required compressed air demand between the minimum and maximum air flow. The compressed air for the pneumatic valves and other components is generated by two SK 22-T series rotary screw compressors, which keep power consumption to a minimum with their premium efficiency motors (IE3). This network can be placed under a maximum pressure of 11 bar – and is subject to much wider fluctuations than the reactor air network. The two-compressor set-up for both networks is necessary to meet the redundancy requirement. In practice, only one compressor runs in each network at any given time, with the baseload machine switched at regular intervals. This ensures an equal distribution of the operating hours across the two compressors and also makes it possible to service the compressors simultaneously – an obvious gain in efficiency.

All components of the compressed air system are controlled and monitored by the SIGMA AIR MANAGER 4.0-4

Geared to quality

Due to the direct contact of the compressed air to the microalgae, its quality is decisive – and the same goes for the compressed air treatment. As mentioned above, the standards are indeed stringent. In figures, as per ISO 8573-1 (2010), that means: Solid Particulate Class 1, Water Class 4, Oil Class 1. KAESER'S engineers have spared no effort to guarantee these targets in the long term. The high quality of the compressed air is ensured by refrigeration dryers of types TL 1301 (reactor air) and ABT 25 (membrane cleaning / control), active carbon absorbers, upstream microfine filters, downstream filters for achieving Particulate Class 1 and several other filter devices. In addition, the pressure dew point is naturally monitored constantly. Another important detail: The compressors are equipped with a food-grade coolant fluid in accordance with the USDA H1 standard. Of course KAESER thought of that, too. All of the components of the compressed air system are controlled and monitored by the SIGMA AIR MANAGER 4.0-4. This provides the operator with maximum clarity regarding the operating conditions, with all data available for retrieval at any time. Maintenance intervals and notifications are also managed through the compressed air management system. Moreover, the consumption and energy data are tracked and logged through the installed visualisation system.

Almost 100% heat recovery

Another design specification from eparella was finally to achieve maximum utilisation of the heat energy released by the equipment, in order to ensure that the system operates as ecologically as possible. For that purpose, the two air-cooled FSD rotary screw compressors were equipped with the PTG 475-25 heat recovery system (plate-type heat exchangers), which achieves an impressive 76%

Photo: ecoduna

The main components of the system are long arrays of 6-metre tall, interconnected glass tubes.

heat recovery quota. The remaining recyclable heat from all installed components helps to meet the heating needs for the greenhouse. During the heating season, the system is switched to air circulation mode: The warm cooling air from the compressor station components is blown into the greenhouse. This permits almost 100% utilisation of the recoverable heat from the compressed air system. In summer operations, the released heat is discharged through the roof to ensure optimal cooling of the components.

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