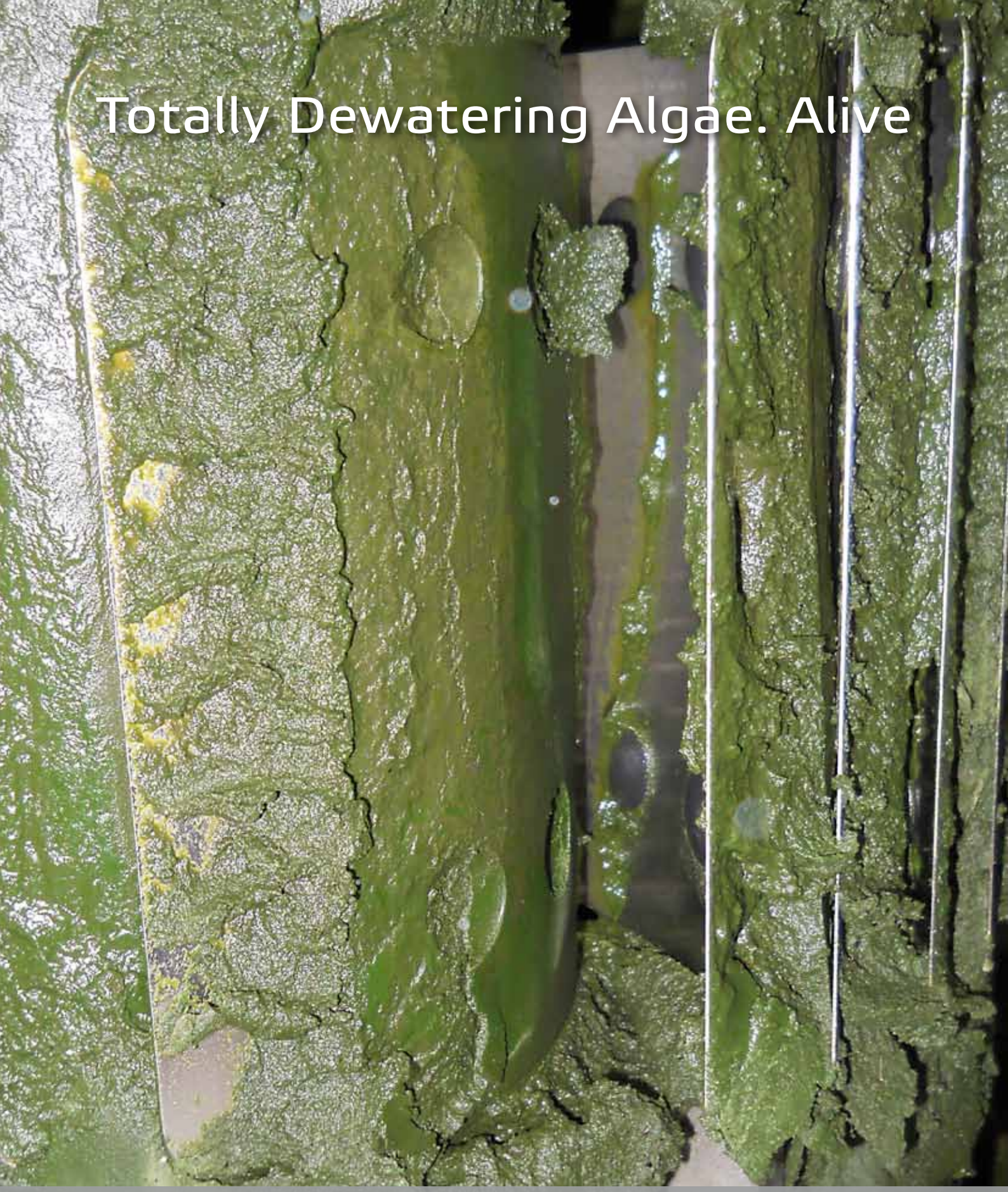
Totally Dewatering Algae. Alive



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The ideal interface between growing and refining

In the dairy industry, the produce of most farmers is processed in one central plant. The interface between the farms and this processing plant is a standard cooled tank in which the fresh milk is stored and from which the product is pumped in the transportation truck.
It is Evodos' opinion that the algae industry will develop in a similar direction. In this perspective, many algae growers will deliver their product to specialized processing plants.
This method demands sufficient shelf life of the algae and a standardized transportation method of the dewatered algae.

Evodos has taken this widely used agricultural harvesting approach as the basis for developing its algae harvesting technology. Whilst harvesting using the Evodos machines the algae are collected as a living organism free of extracellulair water in the form of a paste. This Evodos algae paste is as compact as possible without loosing organic material or changing the structure. Also most bacteria do not appear in the algae paste. This will give you a pure product with the longest possible shelf life and with a minimum of volume.

This method makes the algae paste that is harvested with Evodos the ideal interface between growing algae and further processing. To use the analogy, 'Evodos is the milk cooling tank of the algae industry'. That is where Evodos is positioned in the algae value chain.

Andrew Lawson, Managing Director of MBD Energy, Australia:
"No other centrifuge that we could find on the market meets the challenges of micro algae extraction from water as effectively as the Evodos machines and this is critically important in keeping the cost per weight of harvested algae to a minimum."

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Lowest possible volume

The harvesting process with Evodos results in a totally dewatered algae paste. This is demonstrated on multiple strains varying from the smallest salt water micro algae such as Nannochloropis to sweet water strains such as Chlorella. In all instances the result of the Evodos harvesting process is a Totally Dewatered algae paste that is over 98% free of extracellulair water. The dry solid content of this paste only differs because various algae strains have a different level of intercellulair water. For example, with Nannochloropsis a dry solid content of the produced algae cake is measured of ± 31,5% DW. Harvesting algae with Evodos gives the lowest possible volume.

High value & longest possible shelf life

With the smooth separation and discharge process of Evodos all the algae (100%) are harvested alive. Tests on many different micro algae strains show that there is no shearing nor thermal damage to the harvested algae. No chemicals are added in this process. Most bacteria are not captured in the harvested algae paste.

Since the algae do not change in structure and/or temperature, the value of the harvested product is optimised. The algae remain intact, so there is no loss of biological material in the water fraction. And because all algae are harvested alive, this leads to the benefit the longest possible shelf life. Up to a week.

High quality effluent water

The effluent water after totally dewatering with an Evodos centrifugal has excellent re-use potential. No biomass or lipids are lost during the harvesting process since all algae are harvested alive. This reduces the risk of contamination when re-using

the water for your next growth cycle. And the rise in the water temperature of the effluent is only 0.2 degrees Celsius. This makes it convenient to re-use. And when the Evodos pre-concentration step is applied, there is the added benefit that the effluent water is free of bacteria.

Highest separation efficiency

Total Dewatering is done with the Evodos centrifugal machines. These use the patented Evodos SPT (Spiral Platepack) Technology. The fluid and mechanical dynamics of Evodos SPT are completely different from conventional machinery. With an effectiveness of over 99%, whilst running at high feed flow settings, the Evodos separation sharpness is highest in the industry. For example, the Evodos type 25 machine has a feed flow capacity of 4.0 m3/hour. Results with Nannochloropsis show that even this smallest strain is separated >99% at a feed flow setting of 3.8 m^3/hour. Evodos gives the extraordinary combination of high separation efficiency at high feed flow settings.

Positive energy balance

Evodos centrifugals only require a minimum G-force. The separation process runs under 3.000G and the discharge process under 300G. This is extremely low in comparison with traditional centrifuges. One of the resulting benefits is a low energy requirement. The energy demand of each Evodos centrifugal varies between 0.85 and 0.95 kWh/m^3 feedflow. The 0.85 kWh/m3 is for the direct drive machines. When the dilution of the feed flow is low Evodos applies a pre-concentration step to further educe energy requirements.

The table shows the positive energy balance, even at low feed flow concentrations. There is an energy surplus when comparing the energy content of the algae (5,55 KWh/kg DW) versus the energy requirement for harvesting the algae. Totally Dewatering algae with Evodos clearly is a process with a positive energy balance.

Feed flow concentration		**Separation energy**
gram/liter	kWh/kg DW	Energy balance
0,25	1,9	34%
0,5	1,009	18%
0,75	0,761	13,7%
1	0,53	9,5%
1,25	0,49	8,9%
1,5	0,45	8,1%

Dr. Kirsten Heimann, associate professor at MBD Energy's R&D facility at James Cook University in Queensland:
"All algae are harvested alive with no shearing as demonstrated in tests on multiple strains. The algae are harvested as a paste that is over 98% free of extracellular water. The rise in the water temperature of the effluent is minimal. Only 0.2 degrees Celsius. Micro algae are separated >99% at a high feed flow settings."

For more and the most recent information on Evodos please visit the www.evodos.eu website. This site contains background information on the Evodos SPT technology and cases and references of Evodos users. Performance data on Totally Dewatering algae with Evodos are available as well to provide transparency on performance per strain.

On the Evodos website it is possible to request a proposal for harvesting algae on-line. Based on the data specific to your growth environment a report will be generated that highlights the investment, the energy requirement and the cost per harvested kg algae.

When you need more information we are available to you. Just call +31 76 571 11 70 or send an email to info@evodos.eu

Geronimos Dimitrelos, CEO of Algae to Omega, Florida, USA: "We considered many dewatering technologies and the Evodos machine satisfied both our dewatering requirements and budget. Their novel technology and efficiency will allow us to produce a high-quality, organic product at a very cost effective price point."

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2012/EN/004