Digital Communication in Algae Cultivation

Arc technology helps optimizing yield and growth conditions of algae cultures

Industry: R&D
Application: Algae cultivation
Hamilton products: Polylite Plus H Arc, VisiFerm DO Arc

Figure 1: Panorama view of the KIT laboratory.

Benefits Polilyte Plus H Arc and VisiFerm DO Arc

- Long sensor life time
- Easy maintenance
- Stable and reliable readings
- Intelligent sensor technology

Today algae are commercially cultivated for Pharmaceuticals, Nutraceuticals, Cosmetics and Aquaculture purpose. The abundance of vitamins, minerals, trace elements, and the fatty acid profile as well as the thickening and stabilizing function of the polysaccharides make algae valuable. Algae can also be used to make Biodiesel, Bioethanol or to produce biomass that can be burned to produce heat and electricity. Like plants, algae use the sunlight for the process of photosynthesis. Photosynthesis is an important biochemical process in which plants, algae, and some bacteria convert the energy of sunlight to chemical energy. Algae capture light energy through photosynthesis and convert inorganic substances like CO_2 into simple sugars or oils using the captured energy.

There are several factors, i.e. light, temperature, pH, nutrients, aeration, and mixing, to determine the growth rate of algae. In order to optimize the yield, algae cultivation is done in closed photo-bioreactors. Within these, the process conditions can be accurately controlled, and no infection carrying alga species will occur. The KIT (Karlsruhe Institute of Technology) focuses on development and modelling of phototrophic bioprocesses of green and red algae for the production of high-value products. Major parts of its research are application- and industry-oriented projects, executed in collaboration with academic and industrial partners.

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Arc technology enables quick and easy integration in process control systems (PCS)

For outdoor projects at its site at Campus North as well as for indoor projects the KIT requires robust and reliable pH and dissolved oxygen (DO) sensors with long shelf life. The goal of these projects is to optimize growth conditions, increase the yield of algae products and improve the design of photo-bioreactors. Prior to every run an autoclavation is executed. Additionally the integration into a Siemens S7-1200 PCS had to be easy, fast, and via a digital protocol. For visualization LabView was programmed to capture the data from the S7 via an OPC server. Polilyte Plus H Arc and VisiFerm DO Arc provide a digital Modbus signal directly to the PCS which allowed to reduce the upfront costs of a transmitter. Due to the Arc technology the sensors can easily be calibrated at the lab using the Hamilton Device Manager (HDM) and stored on the shelf prior to the next run if required. Before the VisiFerm was chosen classical amperometric DO sensors were used. This sensor type is susceptible to hydrogen and CO_2 which lead unreliable readings. Some algae tend to switch sometimes from the production of oxygen to the production of hydrogen. A major reason why the Polilyte Plus H Arc was selected is that for long-term cultivations its Single Pore prevents clogging and a constant outflow is ensured. Both sensors require only very little maintenance which allows to control the cultivation from almost any place on earth.

Figure 2: KIT site Campus North.

Features of Arc

- Reduced upfront costs
- Robust digital Modbus or 4-20 mA analog signal
- Calibration in the lab
- Current and historical data to predict sensor life
- Sensor diagnostics for simplified troubleshooting
- Wireless options

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