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Water monitoring systems gain acceptance, manufacturers improve reliability

by Bill Mancini

FORT COLLINS, CO — Fish farming is like no other form of agriculture.

By law across the U.S., aquaculture falls under the same umbrella as dirt farming and ranching. But the aquaculture environment could not be more different than all terrestrial forms of agriculture.

When do corn farmers ever worry about oxygen concentrations around their plants? Never.

When do ranchers ponder carbon dioxide levels around their cattle or sheep? Never.

When does a 10-degree swing in temperature change the growth profile of their animals or row crops? Relatively rarely.

When do all of these environmental factors come into play for fish farmers? Every single day.

The production environment is a major reason why aquaculture can be so challenging. From minute to minute, dissolved oxygen concentration can play an enormous role in the well-being of fish and shellfish, and in more severe circumstances can be the difference between life and death.

Over the years, fish farmers have come to appreciate the importance of the production environment and its sometimes tenuous nature. Depending on the circumstances, water quality can turn on a dime.

A focus of any fish farm manager or employee must be water quality. This job can be time-consuming and labor-intensive, particularly if large numbers of ponds, tanks, or pens are involved.

Managing all of the data collected during the regular course of a production cycle can be challenging as well, not to mention how those data are used to make informed decisions on a timely basis.

For many years—indeed decades in most cases—a group of companies has recognized the importance of water quality testing and monitoring, and has made it their goal to

streamline the process and deliver accurate and reliable results in a cost-effective manner.

With other smaller players in tow, a group of seven companies stands out as the worldwide leaders in water testing and monitoring for aquaculture and other similar applications. They are OxyGuard International (Denmark), YSI (Yellow Springs, OH), Aanderaa Data Instruments (Norway), In-Situ (Fort Collins, CO), Hanna Instruments (Woonsocket, RI), Hach Company (Loveland, CO), and Reliant Water Technologies (New Orleans, LA).

Almost without exception, each of these companies had their beginnings in other water testing fields such as domestic water supply and wastewater treatment, oil and gas, or some other related field.

As aquaculture grew in size and scope, each company understood where aquaculture was headed, and began to develop solutions to the problems encountered by aquaculture producers.

Direct testing of water quality factors such as temperature, oxygen, and pH with single, manually operated probes or sondes (multi-sensor probes) spearheaded the development process. Results when using these instruments were available in seconds.

This was a significant advancement beyond chemical test kits that were tedious and often required more than 5 minutes to develop results, not to mention the cost of reagent chemicals that were consumed in the process.

The first few generations of oxygen probes were based on polarographic membrane technology. Again, the advancements were significant, but not without some drawbacks, including a requirement for water to move past the probe during testing, sometimes unstable calibration, and membrane replacement on a relatively regular basis within harsh aquaculture environments.

Another leap forward in oxygen probe technology was achieved when some developers moved to galvanic electrochemical probes and optical probes. The optical approach eliminated the requirement for water to move past the end of the probe and, in many cases, improved stability of measurements over time. Galvanic electrochemical probes continue to require water movement past the probe for accurate and reliable results, but are very rugged and stable over time and tend to require less maintenance.

Today, in the minds of many, optical probes and galvanic electrochemical probes represent state-of-the-art in oxygen measurement. Both hold prominent positions within the industry. Polarographic technology is still in wide use as well, particularly with hand-held devices used for spot checking.

For many fish farmers, accurate, reliable, and worry-free automated water quality monitoring—collecting good data over long periods of time, not just spot checks by people—is the Holy Grail of aquaculture, and this was the next challenge for equipment manufacturers.

Large aquaculture facilities in particular, or facilities that grow fish at high densities, must monitor and control oxygen on a 24/7 basis, or during key times of the day (e.g., at night in outdoor ponds). Accomplishing this task manually can require personnel dedicated to that task, or large numbers of people with multiple tasks, or both. In either case, employing people can be expensive.

Here is where water monitoring systems come into play.

When you mate oxygen probes and sondes and other water quality measurement devices with controllers that collect and manage data and automatically activate aeration equipment or alarms at appropriate times, you have a system that, on paper, is a dream come true.

Let's briefly look at what each of the seven leading companies has to offer:

OxyGuard International

At their founding in Denmark in 1987, catering to the aquaculture industry was a primary objective of this company. OxyGuard offers a line of hand-held measurement instruments for manual data collection, as well as monitoring, controlling, and data logging devices for automated data collection, aerator control, and data storage.

The Commander (unlimited number of probes), OxyGuard 8 (8 probes), and OxyGuard Multilog (data logging and display) fill the needs for a wide range of facilities.

According to company spokesperson Charlotte Ravensborg, "The company philosophy is to provide no-nonsense measuring and monitoring equipment—equipment that does exactly what is needed with a minimum of maintenance and bother."

YSI

Yellow Springs, Ohio, is the home of YSI and has been for the past 63 years. During that time YSI has played a major role in the water and wastewater industries as well as aquaculture.

According to Tim Grooms, Product Manager for YSI, company growth in aquaculture is at or above overall growth of the industry. YSI has a line of hand-held and automated instruments for measurement of oxygen (featuring their optical probe), conductivity, temperature, pH, ORP, salinity and others.

The 5200A system is specifically designed to handle all of these parameters and control aerators, feeders, and other equipment such as alarms. The 5400 system expands on that capability to handle up to four sets of probes and other inputs.

Aanderaa Data Instruments (AADI)

This Norwegian company began catering to the oil and gas and environmental research markets 40 years ago. More recently, they recognized the growth of aquaculture, particularly in Norway, and developed systems specifically designed for those environments.

AADI instruments measure and monitor oxygen, water current speed and direction, temperature, and conductivity/salinity. They feature the Oxygen Optode optical sensor for use with their Oxyview Program to measure and record data within multiple aquaculture systems.

In-Situ

In-Situ is a Colorado company with roots in water and wastewater management since 1976.

They entered the aquaculture realm more recently with an innovative product called the Wireless Aquaculture System. This floating buoy device monitors and controls oxygen and aeration equipment, is based on their RDO PRO optical probe oxygen sensor, and wirelessly relays oxygen and temperature data back to a central receiver and aeration controller.

The wireless buoy approach is relatively unique in the marketplace, is conceptually elegant, and popular with customers.

Hanna Instruments

Hanna Instruments is an Italian company with a 25-year operating history in the U.S. They do a lot of business in Europe and focus on the mariculture sector.

According to Market Manager Jessica Hoagland, the company offers the rugged and easy-to-use HI8410 Dissolved Oxygen Controller. This device uses a galvanic electrochemical probe, and can be used to activate and deactivate aeration equipment.

They also offer their very new HI9829 system, which measures and records (no control capability) a wide variety of data including dissolved oxygen, pH, ORP, salinity, turbidity, temperature, and many others for up to 30 days.

Hoagland stressed that their prices are very competitive and, as a privately owned company, take great pride in their customer service.

Hach Company

Another Colorado company, Hach, has been in the process instrumentation business for more than 60 years. Within the past 10 years, the Hach aquaculture business segment has grown very rapidly—at a rate of 20-30 percent per year or more—as they have moved into aquaculture environmental monitoring and control, and claims to be acquiring market share from some of the competition.

According to Jeff Allen, Regional Sales Manager within the U.S. Pacific Northwest, their fourth generation optical oxygen probe is “rock solid,” with no accuracy or reliability issues. Mated to their sc200 and sc1000 controllers and other probes, oxygen as well as other water quality parameters can be measured and monitored.

Reliant Water Technologies

The Royce 9300 Pond Monitoring System is the flagship aquaculture product of this company. It is based on a galvanic electrochemical oxygen probe and can be used to control aeration equipment or send alarms to computers or cell phones.

The company caters primarily to the U.S. catfish industry, but also sells to striped bass facilities, and to shrimp and eel production facilities in Asia, Europe, and South America.

Company president Jim Dartez is adamant about his product’s accuracy and reliability, stating his probe sensors will last up to 5 years with proper maintenance, and require calibration as little as once per year.

Monitoring and control systems are not for everyone—particularly small operations with already manageable data collection requirements. Larger facilities with mounting labor costs should take a closer look.

While claims of accurate and reliable operation by manufacturers are encouraging, only time can convince many aquaculture facility managers and owners that these monitoring systems can deliver their promises.

“How do I sleep at night and rely on and trust machines when so many fish and so much money are at stake?” is a question expressed by many facility managers.

Most assuredly, these monitoring systems must be maintained according to the manufactures recommended protocols and procedures. No one is saying otherwise.

Anyone lulled into thinking these systems will function indefinitely without maintenance or attention will be sadly mistaken. The aquaculture environment is harsh and unforgiving.

However, under appropriate and diligent maintenance, a strategy of “supervised automation” (i.e., manpower efficiency, always with an eye to stock safety) can go a

long way to substantially reducing labor costs, and increasing economic competitiveness and profitability.

As the technology continues to improve, as well as experience by management with the technology, comfort levels and trust will continue to rise.

Without a doubt, we will see more of this equipment in place as we move into the future.

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