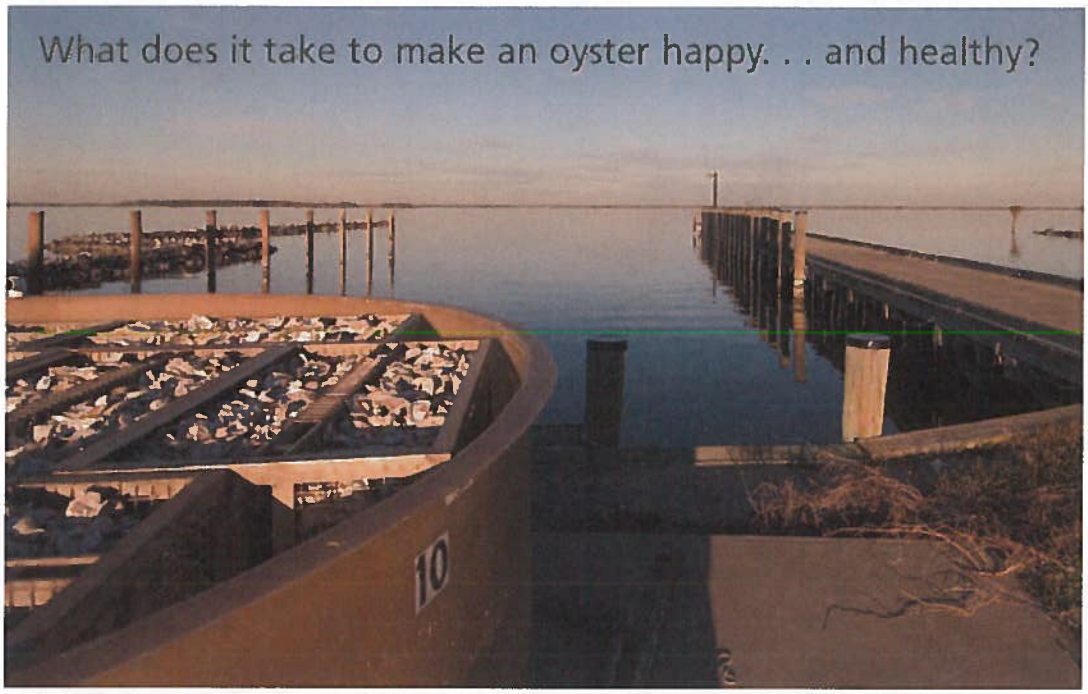
Happy as an oyster in high tide. . .

# How VFDs Are Supporting Critical Aquaculture Research

By Jane Alexander




**The University of Maryland's oyster breeding program relies on carefully planned and controlled stages.**

Certainly, oysters require a particular level of salinity and the right temperature range to be "happy" — conditions typically found in the Chesapeake Bay. Unfortunately, for more than two decades, oyster populations in the Chesapeake Bay, as well as in many other parts of the Atlantic and Gulf coasts have taken a real hit.

Numbers tell it like it is—*starkly*. Before the turn of the century, more than 10 million bushels of oysters, yielding approximately 64 million pounds of meat, were harvested annually, just in Maryland. Nowadays, oyster harvests are being tallied in terms of thousands, rather than millions of bushels.

## What's Happening?

Shrinking oyster harvests are the result of several factors, including over-harvest, and loss of habitat due to environmental pollution. In addition, the bivalves are falling prey to a couple of parasites that are harmless to humans but lethal to young oysters. The first of these parasites, MSX *(Haplosporidium nelsoni)*, thrives in the higher salinity brought on by dry years. The second, Dermo *(Perkinsus marinus)*, tolerates low salinity and is, therefore, more damaging to oyster populations.

As a consequence, those famous native Chesapeake Bay oysters have dramatically gone down in numbers. In an attempt to bolster their population, the University of Maryland has been conducting a study to assess the consequences of introducing the Suminoe oyster to the area. An Asian species, Suminoe oysters have proven to be resistant to the ravaging MSX and Dermo diseases.

## Strictly Controlled Parameters

A 24-month study at the University of Maryland (the University) is examining the Suminoe oysters' eating and reefing habits, as well as their vulnerability to the known native oyster predators. This will allow researchers to assess the feasibility of introducing Suminoes to the Chesapeake. Conducted at the University's Center for Environmental Science Aquaculture and Restoration Ecology Lab, these tests require the Asian oysters to be cultured and observed under strictly controlled conditions.

The lab is a brand new facility with the unique ability to offer both a closed aquatic system and a secure, flow-through system. Other remarkable features include experimental temperature and carbon dioxide controls for climate change research, and a quarantine laboratory for the safe study of non-indigenous species.

For this type of research, several operational requirements need to be in place. Reliable performance of the tank pumps, cooling towers and

### Risks/Rewards in the Oyster Beds

In general, the use of non-native species has been scientifically accepted as a potential option to address a particular native species decline. The actual implementation of this strategy, however, presents several risks. In this particular case, the crucial steps are determining whether the Suminoe oyster can thrive in the low salinity, sediment-laden waters of the Chesapeake Bay; whether it can coexist with the native American species, and, last but not least, whether it can be controlled by the same natural predators.

Why is that a concern? If the Suminoe oysters have no natural enemies in this environment, they can quickly grow out of control and become a serious nuisance, competing for food and space, while not being vulnerable to the fish, crabs and flatworms that prey on the native species.

### The PID Feature

Process systems often require a system-controlled parameter, such as motor speed, to be able to react to variable situations in order to keep other system attributes constant, such as pressure, flow, temperature. A simple example is a metering and dispensing system with a pump powered by a drive, and multiple discharge valves. For flow to be repeatable at each valve, the pressure in the supply manifold must be held constant; the drive speed will need to increase as valves are opened, and be reduced as valves are closed.

A means to meet this requirement is to use a "set-point controller," where the pressure in the manifold is measured with a pressure sensor. This value is compared with a "set point" indicating the value that the user wants the pressure to be. A set-point controller compares the set-point value to the actual value and generates a speed command to the drive to correct the variance or error. The AC Tech MCH builds this set-point controller function into the drive.

One of the most common types of set-point controller uses a PID algorithm. This stands for the three types of adjustments (referred to as "gains") that are used to correct for the error: *Proportional, Integral and Derivative.*

The *Proportional* gain is the most basic adjustment, where the speed command is directly proportional to the error. If Proportional gain is used alone, however, there will always be an error in the system—if *Proportional* gain is set too low, system response will be quite sluggish; if it's set too high, the system will oscillate or grow unstable. To eliminate that error, the *Integral* adjustment will continue to increase the output speed command based upon the accumulated error over time, or decrease the speed in the event of a negative error. The Derivative gain, finally, is used to enhance performance. It basically looks at the rate of change in the error and forces a more dramatic change to the speed command than the one achieved with just Proportional and Integral (PI) alone.

#### Direct and Reverse-Acting Set-Point Controllers

Most set-point controllers are "direct" acting, that is, an increase in the motor speed causes an increase in the process variable that the user wants to change. In some systems, though, an increase in motor speed creates a decrease in the process variable that needs to be controlled. Take the case of a fan blowing air over a heat exchanger, and the temperature of the fluid within the heat exchanger is the process variable to be changed. As the motor speed increases, the temperature of the fluid will decrease! In this case, the user would need to employ a "reverse-acting" controller in order to achieve the desired change.

overall building HVAC systems is a given. The temperature of the water has to be kept within certain pre-determined parameters at all times. Moreover, the filtration pumps need to function without fail. While dependability and efficiency are key concerns in this strictly controlled testing, cost-effectiveness also is an issue.

## Staying on Track

Through its mechanical contractor, J.M. Zimmer, Inc., of Salisbury, MD, the University chose AC Technology's MCH Series Variable Frequency Drives (VFDs) to control the laboratory's pumps, cooling towers and building HVAC system. These drives feature a built-in PID set-point controller function (see sidebar) along with a versatile, automatic 3-contactor drive bypass. This combination of features assures full isolation of the VFD electronics and allows the motor to transfer from "drive operation" and continue running across the line in "bypass mode."

Joe Zimmer Jr., of J.M. Zimmer, Inc., explains the advantage offered by the 3-contactor drive bypass. "Let's say there's an external condition that creates a problem with VFD operations—for example, transient voltage harmonics from the utility causing the drive to trip off on a fault. The MCH drive can be configured to attempt several restarts, but if the condition doesn't clear, the automatic-transfer-to-bypass function will transfer from drive operation to line power, on its own, without any human intervention."

According to Zimmer, if the drive didn't have

**Water comes into the research facility from the Chesapeake Bay and gets conditioned (for purity and temperature) to be ideal for the cultivation of oysters. The temperature of the water must constantly be maintained within strict parameters, and the filtration pumps cannot fail.**

this functionality, a trained operator would have to be on hand, at all times, first to ascertain there was a problem, and then, to manually put the drive into bypass mode. "Utilizing these drives," he continues, "is a way to increase reliability, making sure we maintain uninterrupted performance of the laboratory's pumps, cooling towers and HVAC in general, so research results aren't compromised." He adds that his company bought the 24 MCH drives it needed from Cummins-Wagner Co., Inc., of Annapolis, MD.

Richard Forrest of Cummins-Wagner points out that with all power and control wiring easily accessible and ample wiring space, the MCH is considered to be one of the simplest to install, set up and use of all the HVAC variable frequency drives in the business. "A single-point connection makes the MCH drives less error-prone," he says, "and the on-site warranty adds peace of mind."

As AC Technology's local representative, Cummins-Wagner provided factory-authorized start-up service on-site training and technical assistance, as well as 24-hour emergency service. Zimmer notes that's quite a value-added feature, although such service has still not been required—even after two years of operation.

So, next time you sit down to enjoy an oyster dinner, take a minute to think about how it got to your table. There's a lot more research behind it than you probably ever knew–and there's a lot to keeping that research on track! **P&S**

*AC Technology, Inc., is a member of the Lenze Group. For more information on the products and services referenced in this article, visit www.actechdrives.com or contact Merrill Martin at (508) 278-9100 x129, or mmartin@actechdrives.com.*

**These MCH Series Variable Frequency Drives from AC Technology are controlling pumps, cooling towers and the building HVAC system in the research facility.**