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AQUATIC ECO-SYSTEMS

CASE STUDY

MARINE AQUACULTURE RESEARCH CENTER

SPARUS WITH CONSTANT FLOW TECHNOLOGY ENERGY SAVINGS TRIAL

NORTH CAROLINA STATE UNIVERSITY, MARSHALLBERG, NC

RESEARCH

Can utilization of Pentair Aquatic Eco-Systems Sparus with Constant Flow Technology pumps lead to lower energy costs, improved pump performance, and decreased maintenance in a commercial aquaculture setting?

BACKGROUND

North Carolina State University's Marine Aquaculture Research Center (M.A.R.C.) is located on the headwaters of Sleepy Creek near Marshallberg Harbor in rural Carteret County, NC. Turning down a long gravel driveway, visitors are met with the sight of a modern, weather-resistant building with a bright red metal roof. The MARC facility was constructed in late 2009 for the purpose of conducting research to support innovation in coastal marine aquaculture. NC State University's MARC site has the overall goal of demonstrating the economic feasibility of aquaculture with marine fish species on the North Carolina coast.

The MARC site consists of a 4,200-square-foot building comprised of one large room for aquaculture research; it also contains four smaller wet lab rooms which are equipped with large tanks. A cleanly-organized network of pipes carry freshwater and saltwater to each tank, and a low-pressure air system is used to aerate the water when research projects are underway. The building also includes a specialized lab to conduct water quality analysis, along with an administrative office from which a facility manager keeps the site operating in peak condition. The facility is staffed by two full-time researchers, and is regularly utilized by students, professors and researchers who are interested in addressing the many unique challenges found in aquaculture. The MARC site has been a success since its inception, with over 16 research trials completed. In fact, the facilities' strong track record has led to its recent expansion with the addition of a second research building. The expansion of the MARC site took place in 2014 and will soon support expanded research studies to advance the Aquaculture industry over the course of the next generation.

MARC Site, Marshallberg, NC

System used during energy trial

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EQUIPMENT DEPLOYED

Pentair Aquatic Eco-Systems is a world leader in aquaculture systems, products and technology. Pentair launched the Sparus with Constant Flow Technology pump with the goal of offering an advanced, aquaculture-duty pump to the global aquaculture industry. Pentair Aquatic Eco-Systems recently collaborated with the research team at the MARC site to conduct a real-world field trial of the Sparus with Constant Flow Technology pump.

Figure A

The goal of the collaborative research jointly conducted between Pentair Aquatic Eco-Systems and the MARC site was to examine pump performance and operational costs in an active, operational real-world aquaculture setting. In order to conduct this practical scientific test, Pentair Aquatic Eco-Systems and the MARC site teams deployed a customized array of sensors and data-logging equipment to capture critical operational parameters from the MARC site's aquaculture system. (See *Figure A* which shows the custom controller and data-logging equipment as installed at the MARC site.)

In the initial stage of the test; the monitoring system was connected to a pair of conventional plastic centrifugal pumps that had been in operation at MARC for several years. The conventional design of these pumps meant that they can only operate at one single, fixed speed. During the initial phase of the test period, the Pentair Aquatic Eco-Systems and MARC site teams utilized the on-site monitoring system to capture and log data values for water flow rate, pressure, wattage, amperage, and current. Data points were logged at five minute intervals as the test period commenced.

On day 33, the aquaculture system was stocked with 400 hybrid striped bass. The average size/weight of the stocked fish was 5g. The fish were initially fed a diet of 1.5mm starter feed, and the amount of feed was measured, logged and gradually increased as the fish began to grow. On day 42, an additional 800 fish were stocked into the separate tanks on the same recirculating aquaculture system. These additional 800 fish had an average size/weight of 9.8g. The system on which the test was conducted consisted of three eight-foot round poly tanks, 2-inch PVC plumbing, two bead filters of 24"x42" size, and a large moving bed bio-filter filled with bio-media.

After 100 days of data-logging on the system with conventional pumps installed, Pentair Aquatic Eco-Systems technicians and the MARC site team removed the two conventional pumps from the system, and installed two Sparus with Constant Flow Technology pumps. Sparus with CFT "Pump One" was programmed to 65gpm, while the Sparus with CFT "Pump Two" was programmed to 90gpm.

At this point, the monitoring/data-logging system was re-installed to capture data for water flow rate, pressure, wattage, amperage, and electrical current data. The team again logged data points at five minute intervals. The goal of this approach was for the team to gain the ability to compare the new pump data to the data that was originally logged from the old pumps. In this way, the team was able to directly compare pump performance, energy usage, pressure, flow, cost, and more.

After the Sparus with Constant Flow Technology Pumps were installed, the test was allowed to run for an additional 94 days, and the fish continued to grow. Feed levels gradually increased from 400g/day to 500g/day and beyond. By day 140 of the research trial, feed levels had been increased to 1200g/day. Also by day 140, the average weight of the fish had increased to 118g. Meanwhile, throughout this period of the test, the Sparus with Constant Flow Technology pumps delivered consistent flow rates 24 hours a day.

RESULTS FROM CONVENTIONAL PUMPS:

As the results show, during the initial test period when the system was equipped with conventional pumps, the pump's actual flow rate varied significantly depending on how recently the filters had been backwashed.

When the filters were in a dirty condition, the conventional "Pump One" had an actual flow rate that dropped as low as 66gpm, while the pump's power consumption was measured at 1410 watts. The electrical operational cost for this pump was approximately $3.63 per day, or $101.64 for the 28 day period as shown in *Chart A*.

Just after backwashing, with the filters in a clean condition, the conventional "Pump One" flow rate was observed to be 83gpm, while power consumption was measured at 1417 watts. In a clean filter condition, the flow rate was adequate for the system's needs, but the electrical operational cost was approximately $3.68 per day. The conventional pump's significant fluctuation in observed flow rate means that the flow rate was excessively high for the system's filtration needs when the filters were in a clean condition; while the flow rate was barely adequate for the system's needs when the filters were in a dirty condition.

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RESULTS FROM SPARUS WITH CONSTANT FLOW TECHNOLOGY PUMPS:

Compare the above results to the operational results of the same system after the Sparus with Constant Flow Technology pumps were installed... By examining the data charts in this document, it can be determined that Sparus with Constant Flow Technology pump's actual flow rate was stable at 65gpm, and power consumption was measured at 741 watts to 859 watts. Depending on the relative level of cleanliness/dirtiness of the filter, the Sparus pump self-adjusted to deliver the exact flow rate required in order to meet the system's needs, and the average electrical operational cost was approximately $2.17 per day, or $67.13 per month.

Chart A

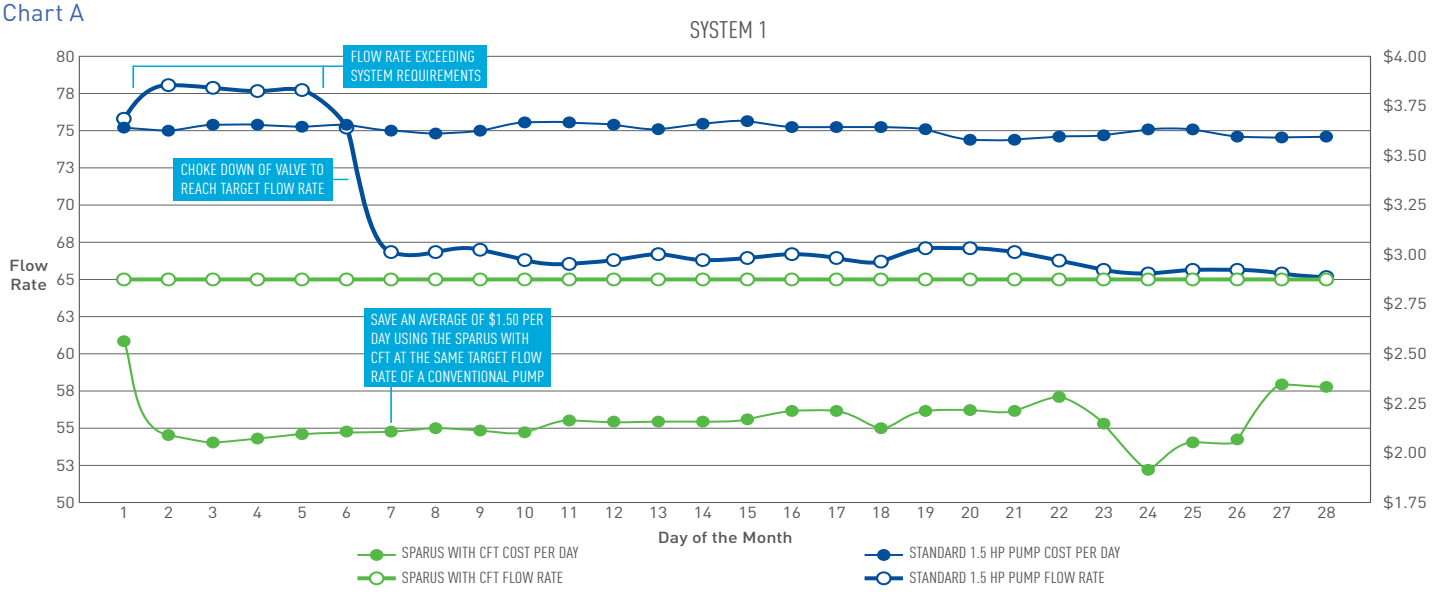
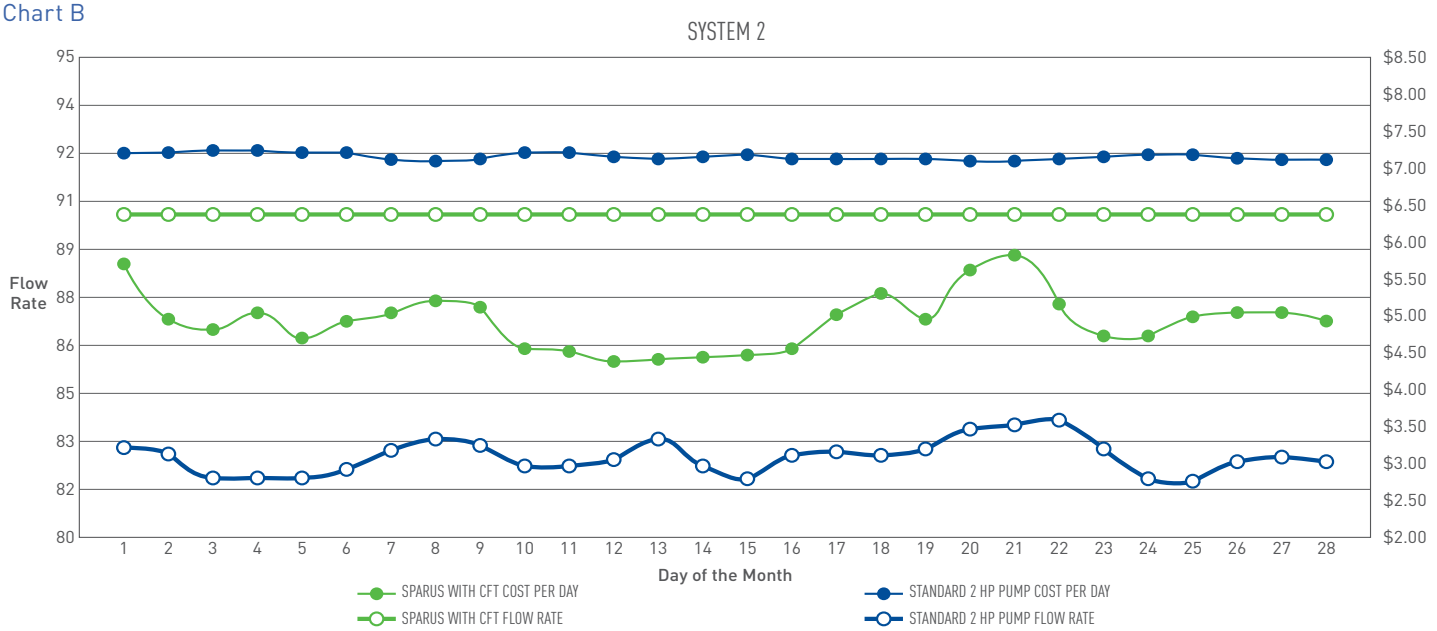


Chart B



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SUMMARY OF RESULTS AND SAVINGS:

The MARC site had previously been equipped with conventional single-speed pumps; and the site clearly benefitted when those pumps were removed and replaced by Sparus with Constant Flow Technology pumps. Aside from stable, constant flow rates, the Sparus pumps reduced operational costs significantly. In fact, when the electrical operational costs of the conventional pumps are calculated for an entire year, the total cost amounts to $3620.64. Compare that expense to the yearly operational costs of Sparus pumps, which is $2382.24. This operational cost difference means that Sparus pumps are delivering the MARC savings of $1238.40 per year, every year.

The electrical cost savings is a direct result of the switch to Sparus with Constant Flow Technology pumps. Additionally, the MARC site research team benefits from other added features of the pump; such as the ability to increase the pump's flow rate during backwashing cycles. Furthermore, the Sparus pump's ability to deliver flow rates from 20 to 120 gpm means that it is extremely flexible and adaptable to a wide range of applications. For example, when fish in a system are small and feed levels are low, the pump can be easily adjusted to deliver a lower flow rate (thereby decreasing energy costs). Then, as the fish in the system grow and overall biomass increases, the pump can be programmed to increase its flow rate to provide better aeration and filtration.

Chart C

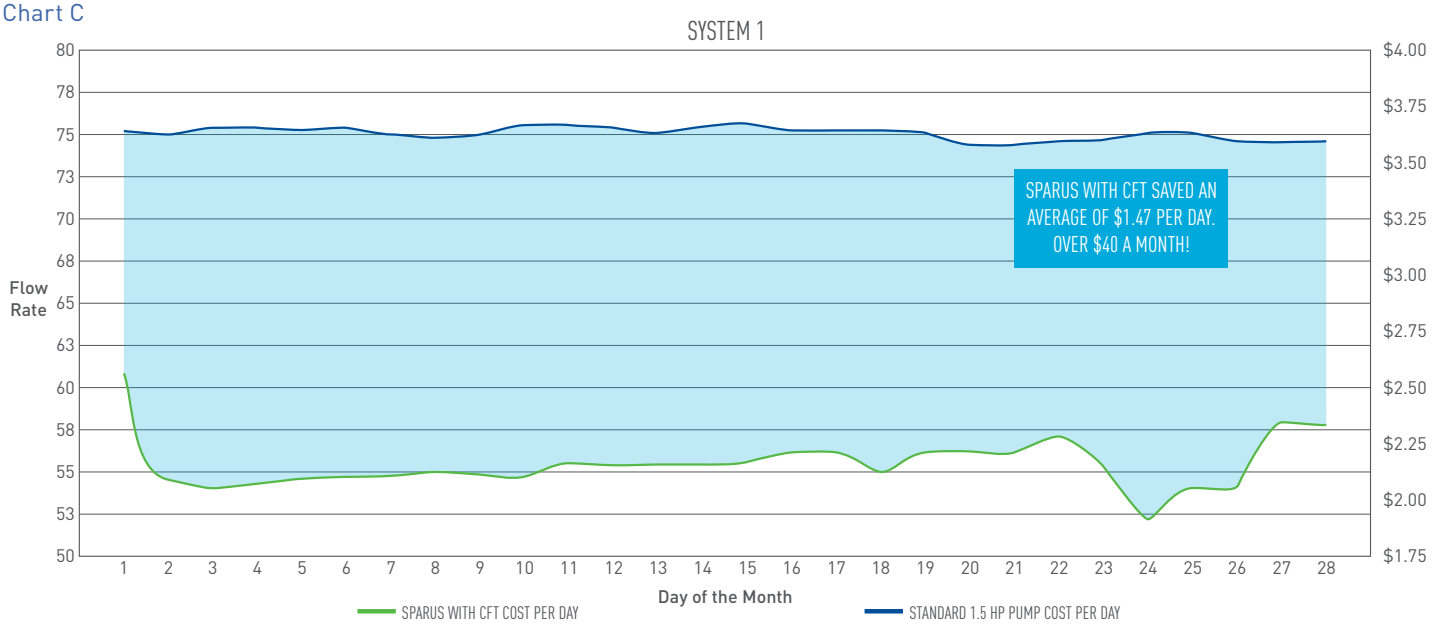
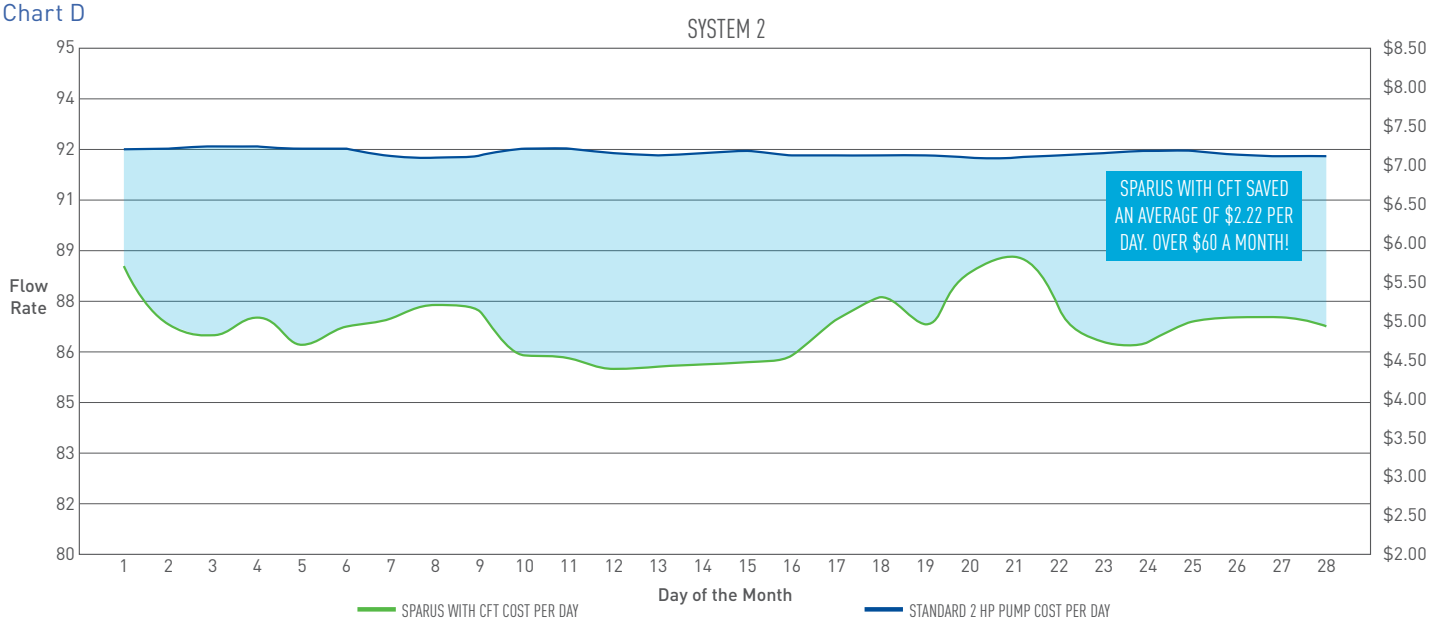


Chart D



SUMMARY OF ADDITIONAL BENEFITS:

Aside from its unique operational benefits, the Sparus with Constant Flow Technology also contains no internal brass parts; the pump's internal fasteners are manufactured from high-grade 316 stainless steel, which is non-toxic to aquatic life forms. The pump also has a premium-quality carbon/ceramic mechanical steel which is backed by an EPDM rubber sleeve and a 316 stainless steel spring. The pump is built from corrosion-proof glass-filled polypropylene, and the motor is rated to NEMA IP55 with Totally Enclosed Fan Cooled construction.

In additional to the quantifiable results noted above, the Sparus with Constant Flow Technology also provides certain user-friendly features that improve the daily and weekly maintenance of the aquaculture system. In particular, the operator of this research trial noted the ability to increase the flow rate of the Sparus with CFT during filter backwash sessions; reducing the time needed to perform a successful backwash.

One of the most noteworthy features of the Sparus with Constant Flow Technology pump is its ability to reduce operational costs while ensuring that water flow rates remain constant, even as system conditions change. The pump features an integrated, on-board Variable Frequency Drive which automatically calculates and self-adjusts to provide the exact operational speed needed to deliver the flow rate established by the user. As system conditions change, Sparus pump with Constant Flow Technology self-adjusts to achieve a constant user-specified flow rate. The result of this technology is that users achieve the absolute minimum energy usage required to deliver any given flow rate. As seen by the real-world test results at the MARC site, this high level of effi-ciency can save thousands of dollars per year in pump operating costs.

"The views and opinions expressed in this Case Study are solely those of Pentair and do not necessarily state or reflect those of NC State University. The above information does not constitute or imply an endorsement by NC State of the product, process, or service, or its producer or provider."

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