Fairbanks Experimental Fish Hatchery Update, Summer 2007

The Fairbanks Experimental Fish Hatchery has gone through several iterations of upgrades and expansion since our last website update. In 2005/6 recirculating aquaculture equipment was installed, improvements were made to media filtration systems for iron and manganese reduction, and our SCADA system for equipment control was expanded.

The expansion provided us with 2 new 16' diameter circular tanks that hold ~5000 gallons of water each. The new tanks allow us to produce up to 10,000 catchable sized (7-10") rainbow trout as well as up to 50,000 fingerling (2-4") rainbow trout for yearly stocking into interior lakes. The two tanks will also be used to compare water reuse versus water recirculation systems as a way of reducing the overall amount of water used in the hatchery. This helps reduce treatment costs associated with having to remove iron from the water. As part of the tank design to reuse water, there are two drains in each tank. The center drain, located in the middle of the bottom of the tank, removes about 20% of the water flow, but nearly 85% of the solids (uneaten fish food, fecal material) produced in the tank. This water is discharged to the municipal sewer. The side drain is located high on the tank wall, designed to remove 80% of the flow, but very little solids. This water stream is the water that is recycled back into the tank (after carbon dioxide removal and re-oxygenation). Fish will be transferred to the larger tanks when they reach ~1g (50mm). Each tank will operate at a flow rate of 117 gpm, of which most will be recycled water. These new systems were operated during 2006/7 to produce fish that were stocked into Quartz Lake during March & April 2007. They will be used again this year to continue rearing studies and produce more fish for lake stocking.

Recirculation system for subcatchable & catchable fish production

The recirculation system is the most complicated of the new systems installed, but also the most conservative with new water requirements. Typically, this system requires only 2% of the total flow to be new water, with the other 98% of the water being reused. The water that is being recirculated must go through additional treatment processes before being pumped back into the culture tank. As the water exits the tank through a side box, it passes through the drum filter which removes all the solids that are 69 microns or larger. The water is collected in a sump, and then pumped through the fluidized sand bed biofilter. The biofilter is a large fiberglass vessel filled with silica sand that serves as a media for bacterial growth. These bacteria convert toxic ammonia, produced by the fish, into less toxic forms of nitrogen. From the biofilter, the water passes through a CO_2 stripping column which removes the dissolved CO_2, generated by the fish as well as the bacteria in the biofilter. After the stripping column, the water is pumped through an Ultraviolet (UV) filter. Here, any bacteria or viruses in the water are killed by intense UV radiation produced by special UV light-producing bulbs. This insures that our fish stay as healthy as possible, as well as reducing bio-fouling of the system. Once the water leaves the UV filter it enters an oxygen cone. This is a pressurized cone shaped vessel where pure oxygen gas is injected into the water. The cone is designed in such a way to increase the gas transfer into the water, supplying oxygen to the water for the fish and bacteria in the biofilter. From here, it flows back into the culture tank, completing the loop. This type of recirculating aquaculture system will be used in the future Ruth Burnett SF Hatchery for long-term fish rearing, to produce catchable trout and salmon.

Partial Reuse system for subcatchable & catchable fish production

The partial reuse system is a far simpler system from the recirculation, but as a trade-off requires a greater quantity of new water to operate. In this system, the water that is being reused exits the side box drain and is pumped directly to the CO2 stripping column to remove the dissolved CO2 produced by the fish. From here, the water is pumped into an oxygen cone, and back into the tank. In contrast to the recirculation system, no biofilter is needed because the higher rate of new water addition dilutes the toxic ammonia to levels which are no longer detrimental to the fish. Because there is no biofilter, which by nature sheds bacteria into the water supply, no UV filter is needed to kill these organisms. Partial reuse systems are typically used to rear fish for short periods of time (1 to 3 months), where using such simplified rearing systems is desirable over more complex fully recirculating equipment that involves biofilter start-up time. This kind of system will be used to produce fingerling fish in the future Ruth Burnett SF Hatchery.

Manganese Dioxide Media Filtration - ATEC Systems

During 2005/6 we re-evaluated our water treatment system used in the past and determined that we could make a similar system perform better, but it would require some changes. One of the first changes that were made was to change media, from the BIRM™ media to a pure ore form of the media called pyrolusite. Pyrolusite is a manganese dioxide ore, instead of a manganese dioxide-coated silica sand, and is therefore of much higher purity. It is adsorptive media that facilitates the oxidation of iron which precipitates onto, and is filtered by, the media. Manganese dioxide ore is also significantly heavier than coated sand, and can withstand much more vigorous backwashes for precipitated iron removal. After a year of using fiberglass residential-grade filtration equipment, we replaced existing filter vessels with industrial-grade steel filter vessels made by ATEC Systems. The system was custom-designed for our application by water treatment specialist of CH2MHill, and mimics the treatment system we will use in our future hatchery. This system uses a 2-stage filtration process to provide the hatchery with a constant supply of clean water, at a flow rate of 60 gallons per minute. The system has been operating quite successfully, typically removing iron from 6 mg/L down to 0.02 mg/L or less. Because the water treatment system is located in the basement of the Aurora Energy power plant and relatively inaccessible, the entire system will be fully automated in operation. This will be accomplished by using automation to control valves and pumps which allow staff to remotely operate and monitor the system. Automation is controlled by specialized SCADA software running on computers in the experimental hatchery.

SCADA System for Process and Equipment Control

Since 2003, we have been using Think-N-Do® software (formerly called Entivity Studio & made by Phoenix Contact) to function as a SCADA (Supervisory Command and Data Acquisition) system. The software is loaded onto both a local PLC device for instrument control, and a PC which serves as a programming platform, supervisory control unit, and data management system. One of the main functions of this software is to monitor and control our water treatment system. The water treatment process involves automating backwash sequences, and controlling water levels in tanks, temperature and flows, and pump operation. The SCADA system also continuously monitors parameters critical to fish life support, such as water flows, dissolved oxygen, pH, and temperatures in the culture tanks. Should any of the crucial parameters deviate from set values, the SCADA system alerts staff to any problem that has developed. The system will also allow staff to monitor the hatchery from remote locations, crucial for reducing reaction times in case of equipment failures, power outages, etc.

Fish Rearing during 2007/8

This year we will receive both eyed eggs and fingerling rainbow trout from Fort Richardson Fish Hatchery in Anchorage. These fish will be reared in both the recirculating and partial reuse systems. After rearing studies are completed, fish will be released into Fairbanks-area lakes. A small-scale vacuum degassing unit will also be piloted at the experimental hatchery, to evaluate the functionality of a tank-level degassing unit used to maintain dissolved gases at appropriate levels for healthy fish rearing.

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