



# NUTS & BOLTS

By MICHAEL HENDERSON

## FROM FLOW-THROUGH TO RECIRC

### *Trends in Hatchery Design and Construction*

**A**ccess to abundant, clean and economical water sources has been the historical priority in driving hatchery design. However, water resources are coming under increasing demand from competing forces including domestic and industrial consumption, agriculture, aquaculture, habitat conservation, and drought. As infrastructure needs increase, public authorities charged with managing the resource may determine that cheap water can no longer be afforded. Impaired water that contains more contaminants than standards allow for a particular use are now being viewed as a viable water resource. Thus, in order to meet growing demands, public authorities in North America and around the world are turning to water treatment and reuse strategies.

Reclaiming and reusing impaired water provides an effective means of conserving limited high-quality supplies, while helping to meet the growing demand for water. For many years, treated effluent discharges have been accepted as an important source for maintaining minimum stream flows. The investment in treatment technologies required to meet restrictive discharge standards has led an increasing number of industries and communities to consider other uses (besides discharge) for their treated wastewater,

as a means of recovering at least part of this investment. Similarly, as the availability of water has become more limited, there has been greater use and acceptance of reclaimed wastewater as an alternative source of water for a wide range of demands.

#### Ongoing challenges

Hatcheries have unique economic drivers that influence their design and construction. In addition to more stringent effluent restrictions, aquaculture production is facing further challenges to become more efficient. Public sector fish-rearing programs, which make up the majority of facilities worldwide, are having to address tightening budget constraints, and private sector hatcheries that supply food fish growout operations must closely manage costs in order to remain competitive in a global market.

The aquaculture industry has responded to this new paradigm in a number of ways depending upon influences specific to different regions of the world. While there is a general trend toward conservation and reuse, the technologies employed and the implementation varies considerably from place to place.

#### Flow-through

Flow-through is the simplest fish culture system involving very limited treatment. Due to the high flow rates required, treatment for the most part is prohibitively expensive, and influent water quality can not be controlled in a significant way. Gas balancing is utilized in cases where deep well water may be supersaturated with nitrogen, and low head oxygenation is sometimes introduced at points along the flow path.

Typical flow-through hatcheries are constructed on the concrete raceway plug flow model where water quality deteriorates along the flow axis. Oxygen is consumed as solid wastes CO<sub>2</sub> and ammonia accumulate. This design concept is still viable and is being implemented in new construction projects, for instance in parts of western North America, where abundant sources of cheap water are still available.

#### Water reuse

Recapturing a portion of the effluent flow, and reusing it to supplement the influent demand of a culture system is becoming a familiar strategy where water supplies are becoming restricted and the demand for fish production remains high. Reusing impaired effluent flow necessitates first, a reduction of the total suspended solids (TSS). This prerequisite becomes an obstacle to implementing reuse strategies in raceways, owing to their inherently slow flushing of solids. Recirculating even reduced concentrations of TSS often results in unacceptable solids build-up over time.

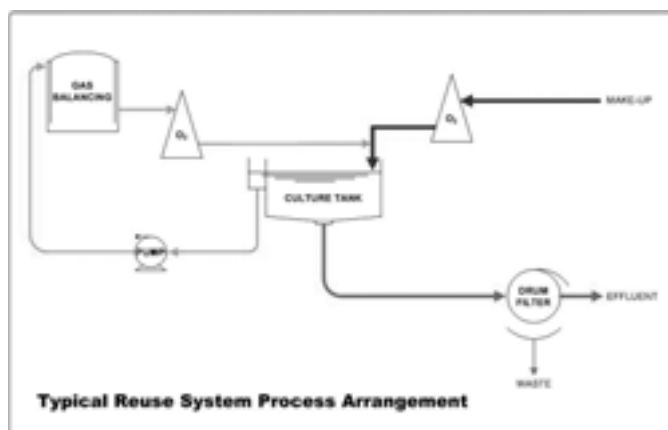
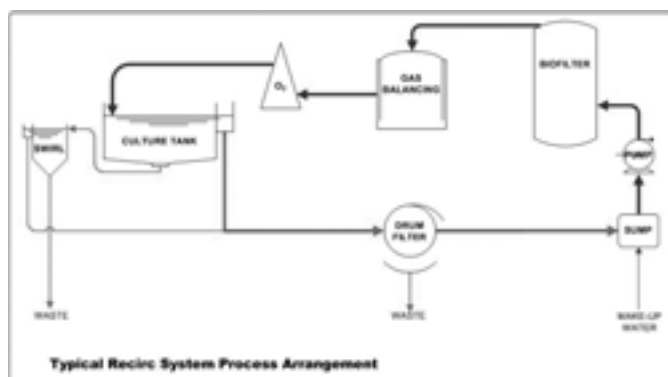
#### Round tanks

More recently, round tanks have been adopted into some flow-through designs as a means of increasing stocking densities. Circulation in the tank helps maintain more uniform water allowing more fish to be reared than in raceways of the same volume. As an additional benefit, the radial flow also allows solid wastes to migrate to the center of the tank where they are discharged from the system, maintaining lower TSS by virtue of this self cleaning action.

Besides TSS reduction, partial reuse water treatment also allows removal of accumulated CO<sub>2</sub>, and the addition of dissolved oxygen



Circular hatchery tanks at Gold River, British Columbia.



to the culture system. The specific technologies employed depend on the percentage of the total flow being treated. Integrated tank-side treatment units are being designed for retrofit applications to gain the advantages provided by partial reuse. Volumes so treated can range from 50-90% of total flow, depending on a number of factors including the species being reared, loading densities, and feeding rates. Higher levels of supplementation are making additional treatment options economically viable since their effect is not immediately lost to the effluent stream. For instance, iron removal processes are making new influent sources accessible and temperature control is being achieved creating further gains in growth performance and fish health. Disinfection of both influent and effluent streams are viable options, and allow hatcheries to create effective firewalls against pathogens.

Round tank flow-through systems are being converted to partial reuse where hatchery operations require more control over water-source consumption, system water quality, and effluent pollution abatement, and improvements in productivity are required. For example, the salmon hatchery industry was an early adopter of the round tank design concept, principally in an effort to optimize productivity. Many of these facilities are now realizing further gains by adding partial reuse water treatment.

#### Full Recirc

Unfortunately, reuse culture systems become limited in the volume of their reclaimed flow by harmful accumulations of ammonia. Full recirculation (recirc) culture systems remove this obstacle with the addition of bio-filtration. While bio-filters can differ significantly in their operational specifications, they all function on the same biological principle. They provide a suitable environment for colonizing autotrophic bacteria to metabolize ammonia as the system water passes through the filter vessel. Bio-filters

...over

## HATCHERY INNOVATIONS

# New feeding system for microdiets

Researchers with the Department of Fisheries in Western Australia have come up with an innovative automatic microdiet (MD)-feeding system for marine larvae.

For years marine larvae have usually been fed by hand, often several times a day, to wean them off live feed; but that is labour-intensive and can easily result in uneven distribution and over-feeding, causing excess amounts of feed to sink to the bottom of the tank.

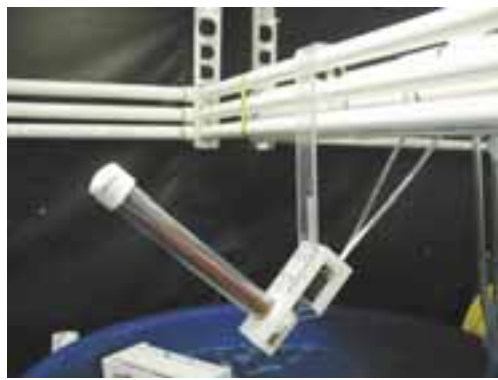
The accumulation of feed particles can foul the tank and promote bacterial growth, reducing dissolved oxygen levels and increasing the risk of larval infection.

Fitted with a computerized controller, the Automatic MD dispenser (AMD) created by Dr. Sagiv Kolkovski, and technical officers John Curnow and Justin Long is a simple, labour-saving system for spreading the required daily dosage of feed in tiny but equal amounts – upwards of 250 mgs at a time.

The AMD system is attached to a programmable logic controller (PLC). Numbers of AMDs can be connected to the PLC, each with its own feeding regime.

Kolkovski said that he came across the lack of suitable feed-delivery systems as a researcher developing and assessing microdiets for larvae.

He said there are still very few, if any, commercially-available feeders able to intermittently or constantly dispense very small



Fitted with a computerized controller, the Automatic MD dispenser (AMD) is a simple, labour-saving system for spreading the required daily dosage of feed in tiny but equal amounts. The programmable device is able to handle diet particles ranging from 70 microns to 1.5 mm.

amounts of MD. Those that are available are for the ornamental market, rather than research or commercial fish hatcheries; and are nowhere nearly precise or accurate enough in their dosage for research purposes. The programmable AMD is able to handle diet particles ranging from 70 microns to 1.5 mms and each time the same amount of feed is released.

The AMD system is now available through the Department of Fisheries' North Beach offices in Western Australia. A patent registration is pending.

Information: [skolkovski@fish.wa.gov.au](mailto:skolkovski@fish.wa.gov.au)

## Jobs

### Assistant Hatchery Manager

Grieg Seafood BC Ltd., a dynamic and growing company in the aquaculture industry is currently seeking to fill the position of Assistant Hatchery Manager for our operations in Gold River.



- You will be responsible for leading a crew in day-to-day operations of the hatchery.
- You will be knowledgeable with feeding systems, grading, fish husbandry, smolt transport, fish health, site maintenance, thorough record keeping, and equipment up-keep.
- Knowledge of all aspects of bio security procedures.
- You will report to the Hatchery manager and work with another Assistant Hatchery manager and the Maintenance manager.

The successful candidate must be willing to learn, have a background in fish husbandry and will be an effective communicator, team leader, and strategic planner.

You will be highly motivated and organized, with an extremely positive attitude.

An educational background related to the field would be an asset.

Computer proficiency required.

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Campbell River, BC V9W 2C2, Canada  
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Only those applicants selected for interviews will be contacted. We thank all other applicants for their interest in the position.

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## Nuts and Bolts *Continued from page 29*

enable hatcheries to operate in a near closed loop, where the only water losses are through evaporation, and solid waste removal. Make up water then is reduced to a relatively small fraction of the total system volume. From the standpoint of water chemistry as it affects fish health, just enough make up flow is required to maintain acceptably low concentrations of trace minerals and salts which could otherwise accumulate to harmful levels.

When makeup water volumes become low enough to treat economically, additional opportunities arise that enable hatchery operations to exert ever greater control and reap the rewards of improved productivity.

### Europe a leader

Europe has been the leader in very tight recirc system implementation as a result of a mature 'water market' and some of the most rigorous pollution abatement standards applied to aquaculture effluent discharges anywhere in the world. Private sector hatcheries in this region of the world commonly report makeup water requirements in fractions of a percent of system volume.

Hatchery operations around the world both public and private have been paying attention to the shrinking supplies of clean potable water, and the economic advantage that has been afforded to practitioners who have adopted sound strategies for the future. In Chile, recirc hatcheries are being built by European and domestic companies, in advance of inevitable toughening environmental law, and to maintain a competitive edge in the global market (See Hatchery International, Vols 5/4; 5/5, 2004).

### North American recirc

In North America, commercial salmon hatcheries began adopting recirc system technologies over a decade ago. Publicly funded hatchery systems, frequently with an aging infrastructure dominated by raceways, are seizing development opportunities to take advantage of water reuse technologies in the greater public interest of water conservation and to improve the effectiveness of hatchery operations. There is a growing trend to consider water reuse as a central element of integrated and sustainable water resource management. As high volume users of the water resource worldwide, aquaculture industry leaders recognize their responsibility and are responding with appropriate, productive, and sustainable solutions.

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