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Aquatic Facilities: Think Beyond 'The Guide'- Part II: Water

Overview

Water is the life support medium in an aquatic facility. Keeping the intake water and the distribution system clean and devoid of impurities and fish pathogens is paramount to the success of the research.[1] Slight variations in water quality may be toxic to the fish. The design engineer should consult with a knowledgeable fish health professional and conduct a comprehensive analysis of water quality parameters before a fish holding/testing facility is planned. The water supply must be compatible with the fish species to be housed.

Water

Water in the aquatic facility must be tailored to the specific aquatic species and must be closely monitored to avoid disastrous effects on the population.[1, 2] The following factors require special attention.

ions	pH	hardness
salinity	ammonia	nitrates
Chlorine	dissolved O_2 &CO_2	

The water supply should be evaluated for:

- Sufficient capacity
- Need for a carbon filtering system or a reverse osmosis system[3]
- Effect of phyto- or zoo –plankton blooms, tidal cycles, seasonal water mass turnovers, lake turnovers; removal of chlorine or other disinfectants; reduction of suspended sediments, release of supersaturated gases, or elimination of pathogens[3]
- Metal ions, which can leach from the piping materials used in municipal systems such as:
  - Zinc from galvanized iron piping
  - Copper from copper piping and brass fittings if levels exceed 5µg/L
  - Cadmium from solder used in copper fittings.
- High levels of metal ions or CO_2, nitrogen and other gases, which may be present in well water.
- Aerosol contamination from overhead materials or release of toxic vapors and condensates.[1]
- Incoming water temperature and purity

Materials, finishes and equipment must be selected to withstand the moist environment.

- Specify materials/finishes to prevent corrosion and galvanic reactions based on chemicals and type of water that will be used.
- Ensure proper air supply and temperature regulation to prevent excessive condensation while maintaining a suitable work environment for research staff.[4]
- Surfaces should be sealed, smooth, easily cleaned and made of impervious material.
- Floors should be non-skid and coved.
- Materials such as fiberglass polycore for ceiling systems and Trespa for countertops and sinks are recommended.[5]
- Porous materials, organic materials and materials prone to de-lamination should be avoided.[1]

Types of Water Systems

Aquatic systems are either static or flowing. Static systems will not be discussed in this forum.

1. **Flow-through systems** require a continuous supply of large quantities of water of a consistently high quality.[3]

2. **Recirculation systems** use a series of processing stages that may provide:
   a. Separation of large suspended solids (uneaten food/feces)
   b. Fine filtration
   c. Processing to reduce solids, chemical oxygen demand, dissolved organic carbon, and to re-oxygenate the water
   d. Removal of dissolved organic materials (foam fractionation)
   e. Disinfection
   f. Biological filtration/nitrification/denitrification
   g. Toxicant removal with activated charcoal.[3]

Water System

- The water system supporting the various components of the aquatic system must be sized properly.
- A flow monitoring system should be incorporated in the system to detect a loss in pressure or decline in water levels.
- Performance should be monitored by flow, concentration of dissolved gases, temperature, pH, salinity, etc.
- Rust proof floor drains should be installed in all tank and procedure rooms. Floors should be sloped 3-10 mm to the drain. Drains should have a trap to collect organic matter, should be accessible for cleaning and pest management program inspections.[3] Flood proofing should be considered especially if the holding tanks are on an upper floor.
- Water supply lines should be secure, protected from disruption and comply with local regulations.
- All lines should be labeled.
- Supply and drain lines should be cleanable by simple, low technology methods.
- Pressure gauges and flow meters should be installed at points throughout the system to monitor the condition of the lines and the performance of the pumps and filters.
- All compressors providing gases to the system should have devices to remove moisture, and oil traps to prevent any oil that leaks from compressors from entering the fish tanks through the aeration system. Food-grade lubricants should be used.[1]

1. Canadian Council on Animal Care (CCAC), Guidelines on: the care and use of fish in research, teaching and testing. 2005, Pp. 21-30.
2. National Institutes of Health (NIH). Design Requirements Manual. Bethesda, MD. NIH, Division of Technical Resources, 2008. http://orf.od.nih.gov/PoliciesAndGuidelines/BiomedicalandAnimalResearchFacilitiesDesignPoliciesandGuidelines/DesignRequirementsManualPDF.htm
3. Fisher JP. , Facilities and husbandry (lg.fish models). In: The Laboratory Fish. (ed. G.K.Ostrander), pp. 13-39. San Diego CA: Academic Press. 2000
4. Bailey, A. Planning for Aquatics, ALN, January 01, 2009
5. Bartlett, D. Aquatic Facility Design-Designing for Atlantis? Lab Animal, Jan 1, 2005.