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Aquatic Facilities: Think Beyond "The Guide" - Part I: Defining the Facility

Overview

Zebrafish (*Danio rerio)* and amphibians are frequently used as models to study development and disease patterns. It is critical to identify the unique aquatic facility considerations early in the project design by including experienced users and operations and maintenance staff in the planning process. The facility must be designed to minimize stress to the animals (fish), promote efficient operation of the facility and ensure a safe working environment for personnel.[1] Many operational and procedural functions such as protocols and standard operating procedures will have an impact on the design and should be reviewed prior to design. An aquatic facility is less flexible than a rodent facility in terms of making changes once the tanks are locked in place. Design assumptions made for dry animal labs cannot necessarily be translated to the aquatic facility. A balance between the location of the aquatic facility and the flexibility of adjacent spaces must be reached to address obtainable growth potential.[2] The weight of the housing systems, water supply and water quality must be given particularly close attention when designing a research aquatic facility.

This series addresses many of the unique features and procedures of an aquatic facility. They include 1) the impact of water; 2) the impact of the MEP and HVAC system and 3) the role of biocontainment in the design.

Identify Type of Facility and Space Required

Aquatic facilities can be categorized as follows:

1) ***Mini-Facilities*** are very small installations having fewer than four multi-tank racks.
2) ***Multi-Rack Facilities*** are composed of more than four racks of aquaria.
3) ***Core Facilities*** are multi-rack facilities that support multiple labs. They may have core support staff; unique workflow patterns and experience large surges in capacity.
4) ***Integrated Vivariums*** are facilities where the aquarium and dry vivarium are integrated into a larger vivarium.
5) ***Isolated Systems*** are small/medium sized facilities that may use decentralized water systems for containment.
6) ***Centralized Systems*** are medium/large facilities that may centralize the life support systems.[2]

Each of these facility types has its own unique design and operational needs. However, they share several common features. The following areas should be considered based upon program requirements:

- Nursery, food prep and procedure rooms nearby the tank areas.
- Repair shop with storage capacity for equipment and adequate general supply storage.
- Quarantine area, transfer areas, foot and hand cleaning stations, restricted access.
- Access to a fume hood with adjacent holding space.
- Sink and bench space in each module.[3]

Pumps and other mechanical equipment associated with the aquatic facility should be located away from the holding rooms, since they cause noise and vibration. Sound and vibration attenuation strategies should be employed. [1,3]

The following should be considered for feed storage:

- Dedicated areas that are dark, temperature and humidity controlled, and pest-free
- Daily feeding bins conveniently located
- Dry feeds should be stored at temperatures < 20°C and humidity < 75% RH.[1]
- Refrigerators and Freezers for storage

Fish Tanks and Racking Systems

Aquatic environments should be designed to meet the established physical and behavioral requirements of the fish and amphibians. Consideration should be given to species-specific requirements of the animals. Water flow, flow direction, depth of the tank and size of the fish species will affect tank size and thus the rack system.[4] There are several common types of tank/rack systems.

- Tanks situated on a rack shelf
- Tanks situated on metal bars,
- Tanks hang from their rims.

The users must discuss and consider the advantages and disadvantages of each system in their facility. The turnover time of water in a holding tank is important for tank hygiene and is a function of species, stocking density, social behavior, dissolved gas levels in influent water, the tank configuration and feeding frequency. A graph is available to estimate 90 to 99% molecular replacement times based on flow rate and tank volume.[4]

Tank size and the age (size) of fish housed should be considered in terms of the program requirements. The investigators must determine the numbers and kinds of fish to be housed, how the fish will be used, proportions of the different racks (nursery, single fish, small family, larger groups), and work flows involving other work areas. Most racks only hold certain tank sizes. Although racks are not frequently moved, similarly sized racks for different size tanks simplify rack unit exchanges when facility needs call for it. Balancing these factors should result in a more smoothly functioning facility.[5]

References & Resources:

1. Guidelines on: the care and use of fish in research, teaching and testing. 2005, Pp. 21-30.
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4. Sprague JB., Measurement of pollutant toxicity to fish I. Bioassay methods for acute toxicity. Water Research 3:793-821.1969.
5. Trevarrow, B. Rack 'em Up -- Racks for Tanks for Small Fish in Biomedical Aquatics Facilities, ALN January 01, 2009.