



SUSTAINABLE RAS DESIGN USING A VAL™

A Case Study in Sustainable Recirculating Aquaculture System Design using a Vacuum AirLift™

Situation

The intensified rearing conditions present in Recirculating Aquaculture Systems (RAS) present numerous challenges to the fish farmer. Management of water quality becomes paramount in the high density rearing conditions. The fish rapidly deplete the O₂ supply while producing CO₂ and solid waste. These actions quickly create an adverse environment if not properly addressed.

Requirements

The essential elements of RAS water management are circulation, clarification, biofiltration, degassing, and aeration. These elements provide an environment conducive to the health and growth of the fish by removing unwanted fine particulates, dissolved solids and waste gases produced by the fish while replenishing the O₂ consumed in respiration by the fish. Due to the competitive market created by wild caught fish, the water management system must have low acquisition and operating costs while providing simple and reliable operation.

Traditional RAS

The major components of the typical water reuse system are 1) the rearing tank for raising the organisms, 2) a mechanical filter for removing settled and suspended solids, 3) a biological filter for oxidation / reduction of total nitrogen, 4) UV or ozone disinfection to control bacteria and other pathogens, 5) a gas stripper for reducing CO₂ and N₂, 6) a pump for recirculating the treated water, 7) aeration / O₂ injection to restore depleted oxygen levels and 8) a skimmer for removing large / floating particulates.

There are several challenges / limitations with traditional systems:

Removal of suspended solids below 40 µm is difficult in traditional approaches such as drum, screen or sand filters which are not effective due to pore size versus pumping cost limitations. Fixed screens or rotating microscreens are limited in their effectiveness below 40 µm due to poor flow capacity leading to higher pumping costs and increased cleaning frequency. Sand filters are likewise limited by high head loss and the need for frequent maintenance.

UV or ozone disinfection is expensive due to the energy costs associated with generating UV or ozone.

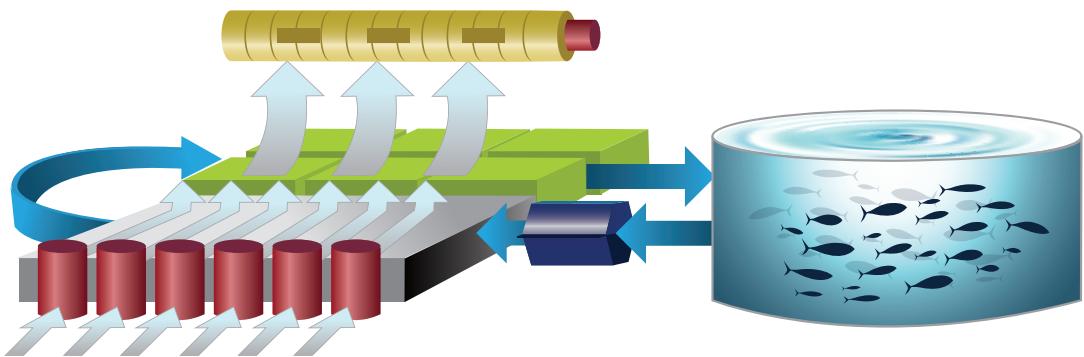
Stripping of undesirable gases, CO₂, N₂, etc. consumes energy and requires significant floor space to house the stripping chamber. In addition, the gases are frequently released within the building housing the RAS causing increased heating, ventilation and air conditioning (HVAC) costs.

Each of these challenges requires a specialized piece of equipment that 1) increases capital equipment costs, 2) requires additional floorspace thereby limiting production capacity and 3) increases operating costs due to additional energy consumption and increased maintenance.

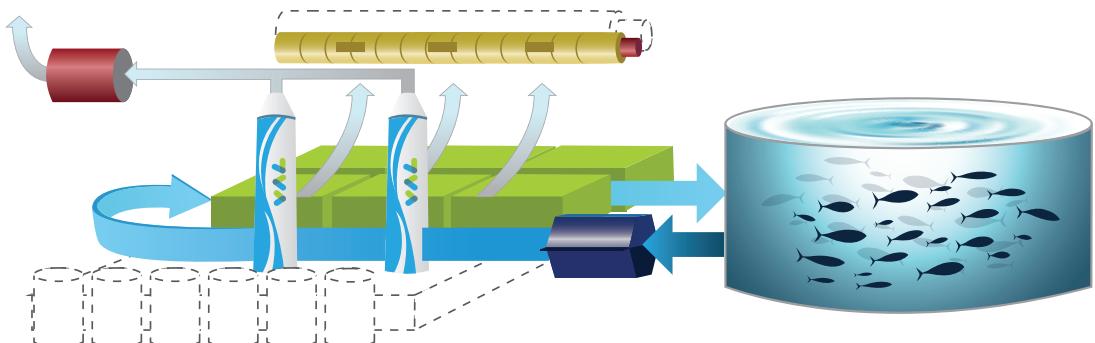
Our Solution, the VAL™ Based RAS

The Vacuum AirLift™ (VAL™) provides a multi-functional solution to RAS water treatment and management. The VAL™ is a patented technology that provides water circulation, gas exchange and particulate extraction in a simple, reliable and energy efficient device. The VAL™ continuously extracts fine particulates and pathogens through foam fractionation that contaminate fin fish rearing water. If left untreated this contamination leads to off flavor, biosecurity issues and risk of human illness or death. In addition, the VAL™ extracts CO₂, N₂, H₂S and other undesirable dissolved gases while replenishing the O₂ consumed in the rearing and denitrification processes.

Traditional RAS



VAL™ Based RAS



Space And Equipment Saved

The VAL™ based system streamlines the design by providing the water circulation, suspended solids / pathogen removal, degassing and aeration in a single, simple, energy efficient device. The VAL's™ unique design allows it to capture waste gases and discharge them outside of the building greatly reducing HVAC costs. The illustrated example layouts provide a comparison of the equipment and floor space requirements for the water management system in a traditional and VAL™ based RAS.

The multifunctional performance capabilities of the VAL make it a uniquely powerful tool for sustainable RAS water management. A number of benefits accrue as a result of this performance:

- 1 Lower CAPEX due to reduced equipment cost
- 2 Lower OPEX due to reduced power consumption
- 3 Reduced equipment footprint
- 4 Increased reliability due to less complex equipment
- 5 Reduced or eliminated use of chemicals / consumables
- 6 Reduced maintenance due to equipment simplicity
- 7 Optimized, reduced or eliminated use of ozone
- 8 Optimized, reduced or eliminated use of UV
- 9 Increased margin due to lower overall costs

This case study review validates the VAL™ as a highly effective tool in addressing water circulation, particulate removal, degassing, aeration and other aquaculture water management and biosecurity issues.