

# **Low Head Recirculating Aquaculture Systems (LHRAS)**

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Energy can be one of the largest variable costs in the operation of a recirculating aquaculture system. One way to reduce pumping costs is to utilize low head equipment. For the purpose of this presentation, low head will be construed as less than 8 inches (20 cm) total head for the system. Total head can be defined as the sum of the head required by each component in the recycle path.

A low head recirculating aquaculture system has been designed, constructed, and is being tested at the Virginia Tech Aquaculture Lab. Each recirculating system contains two grow-out tanks; a filtration vessel containing a microscreen drum filter; and four rotating biological contactor (RBC) biofilters; sixteen airlift pumps (eight per tank); a regenerative blower with air lines, vacuum lines, and air distribution manifold; a discharge pipe; and a fresh water supply. Each grow-out tank (20 feet [6.1 m] long, 5 feet [1.5 m] wide, and 3.3 feet [1 m] deep) holds 2468 gallons (9342 liters). The filtration vessel is 22 feet [7 m] long, 2 feet [0.7 m] wide, and 2.25 feet [0.68 m] deep and contains 740 gallons (2802 liters). The microscreen drum filter consists of a 22 inches (56 cm) diameter drum covered with 120 $\mu$  stainless steel mesh screen, a 10 inch (25 cm) diameter pipe/axel, a stainless steel frame, vacuum head, and a 0.05 hp (38 kW) gearmotor.

Each tank has a 6-inch airlift distribution manifold with eight, two inch airlift pumps evenly distributed across the width of the tank. Each airlift provides 25 gallons per minute (G.P.M.) for a total flow of 200 G.P.M. (95 lpm) per tank. Each of the four RBCs are 4 feet (1.2 m) in diameter, 20 inches (50.8 cm) wide, with approximately fifteen hundred square feet (140 square meters).

A regenerative blower provides air and vacuum for two systems (four tanks). The blower has a 1.5 horsepower (1.1 KW) electric motor and supplies 96 SCFM (standard cubic feet per minute) (2.7 cubic meters per minute) of air at 30 inches (76 cm) of water pressure. The single regenerative blower produces energy for water movement (airlift pumps), rotation of the RBCs, and vacuum for solids removal from the drum filter. A single discharge pipe removes effluent from the microscreen drum filter vacuum head and discharges the waste into the sewer system. The fresh water supply line is used for water replacement.

In operation water flows from each grow-out tank through an 8-inch (20 cm) PVC pipe into the first section of the filtration vessel (Figure 1), through the 120  $\mu$  screen on the drum filter, across the four RBCs, through a 6-inch (15 cm) PVC pipe to the eight 2 inch (5 cm) diameter airlift pumps. The airlift pumps lift the water from the filtration vessel

into the grow-out tanks. The airlift pumps also add oxygen to the water and remove carbon dioxide. All of the system water passes through the filtration vessel six times per hour.

**FIGURE 1: Schematic of the Low Head Recirculating Aquaculture System being tested at the Virginia Tech Aquaculture Center, Blacksburg, VA.**

