

SEAWATER CIRCULATING SYSTEM IN AN AQUACULTURE LABORATORY

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ABSTRACT

The note gives an account, for the first time in India, of an Aquaculture Laboratory with open type seawater circulating system developed at the National Institute of Oceanography, Goa, India. Besides describing the details of the system and laboratory, the advantages, disadvantages and modifications desired are highlighted.

Key-words: Aquaculture laboratory, sea water circulation.

Most of the leading oceanographic laboratories of the world have indigenously developed seawater circulating or even recirculation facilities and the details are well documented (Anon, 1959; Wilson, 1960; Clark and Clark, 1964; Lasker and Vlymen, 1969; Bohl, 1971; Hawkins, 1971; Mock and Neal, 1975 and Currie, Blaxter and Joyce, 1976). However, in India, inspite of a long marine sciences history, there is no published report about the running sea water circulating system to the best of the author's knowledge.

An aquaculture laboratory, with open type sea water circulating system and all other modern facilities, has been in operation at the National Institute of Oceanography, Goa, since May 1981. This note describes the details of the system including operational aspects, advantages, constraints and also outlines briefly the proposed modifications, for better utility.

The Pumping System: A 15 HP centrifugal pump (Wasp series) fitted with stainless steel impeller is used for drawing the sea water. The pump is fitted on a cement concrete platform, on a flat surface of a laterite rock, about 2.5 m above the sea level. A prefabricated RCC casing, protects the pump from sea water spray. Intake pipe, 90 mm thick and 7.5 m long, heavy duty flexible PVC, is fitted with a gunmetal foot valve and the pipe is clamped to the lateritic rock. Thus the drifting and displacement of the hose is prevented (Fig. 1a). The intake pipe pumps water from a specially made and permanently submerged pit of 2 m³ volume. The pit located amidst the vertically slopping lateritic rocks, ensures clear water, with negligibly low silt or sand. The pump operates on 440 volts, three phased AC mains. The delivery end of the pump, which is also used for prime, is a 75 mm thick and 72 m long PVC flexible pipe and is connected to the settling tank.

The Tank: The delivery pipe empties into a reservoir-cum-settling-cum-prime tank having a storage capacity of 200,000 litres (Fig. 1b). The tank

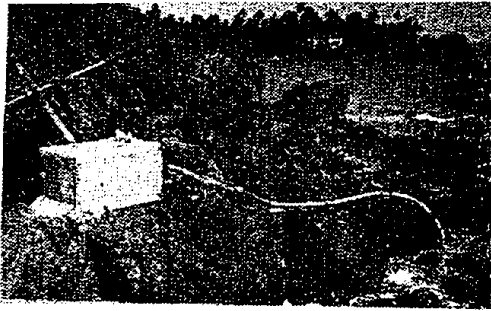


Fig. 1a. Location of the pump and the suction hose pipe.

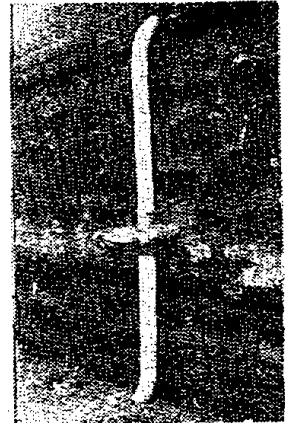


Fig. 1b. Storage-cum- settling tank.

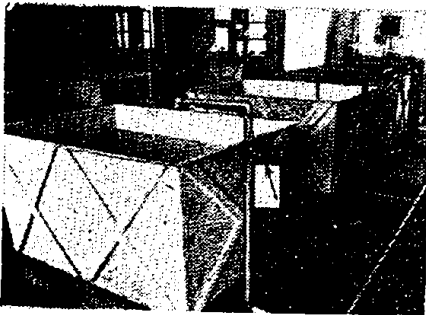


Fig. 1c. Fibre glass tanks and flow system.



Fig. 1d. Outlet from a culturing tank.

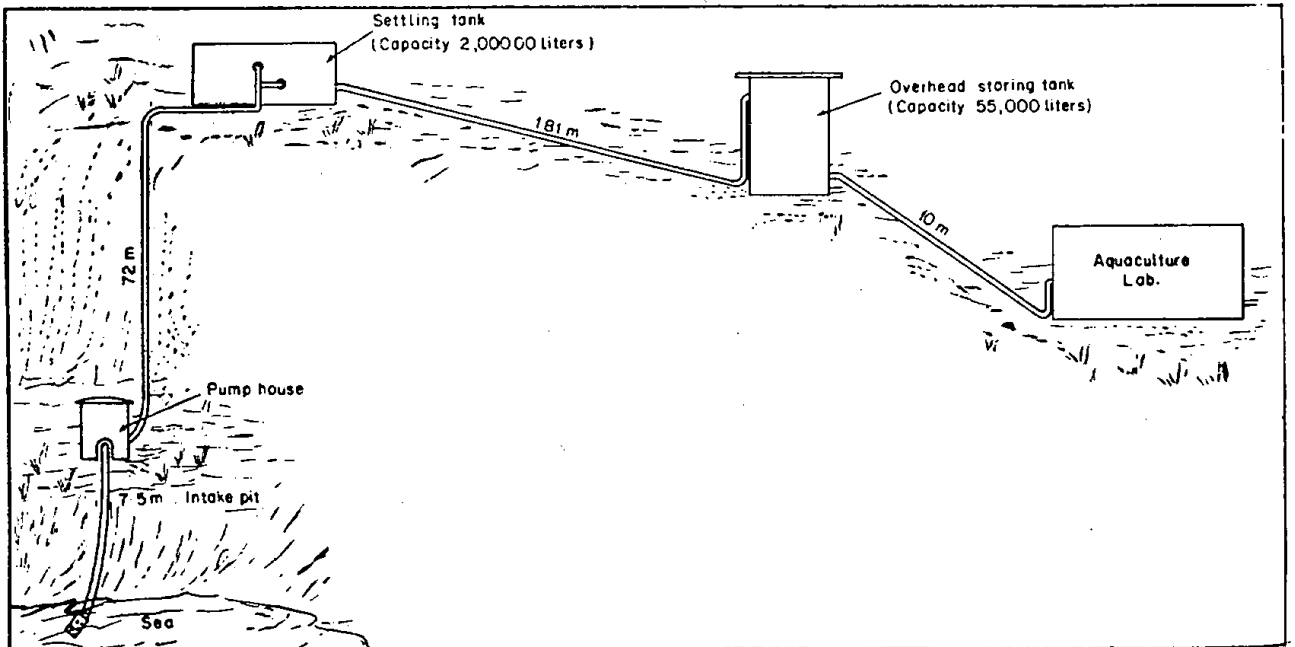


Fig. 2. Schematic diagram of running seawater system.

built with laterite rocks and is covered with a cement concrete slab, with two manholes (each of 0.75 m^2 in area) with replaceable covers of fine mesh. The delivery pipe opens into the settling tank, at a height of 1 m above the ground level and thus the backwash is prevented. The settling tank is situated atop a cliff about 26.5 m above the sea level.

The water from settling tank flows through a 63 mm thick and 181 m long rigid HDPE pipe, by gravity gradient to an over-head tank (capacity 55,000 litres) near the aquaculture laboratory (Fig. 2). The flow from settling tank to the overhead tank is regulated by a PVC diaphragm valve of 63 mm diameter. Sea water from the overhead tank flows into the laboratory through a 63 mm thick 10 m long rigid PVC pipeline.

The Aquaculture Laboratory: The laboratory is a cement concrete building with asbestos roofing. It has a floor area of 100 m^2 and is located on a cliff about 22.8 m above the sea level. An air-conditioned cubicle (Fig. 3) serving as constant temperature chamber, occupies $2.7 \times 7.5 \text{ m}$ area of the laboratory.

Internal Flow System: The contact of sea water with any metal is completely avoided by using non-metallic pipes, conduits, valves and tanks. The main supply line (Fig. 3) is of $40 \text{ m} \times 6 \text{ kg f/cm}^2$ PVC rigid pipe. It branches into 3 distributing lines—each of 32 mm rigid PVC pipe, fitted with 32 mm diameter diaphragm valve at the intersection. Each of this line, supplies sea water to 12 fibreglass tanks (1.2 m^3 volume, each) arranged in four rows of three each (Fig. 1c). The outlet (32 mm diameter) from each of the tank, is fitted with threaded adaptor on which a nylon net or bolting silk of desired mesh size can be fitted (Fig. 1d).

An additional PVC conduit (32 mm diameter and 20 m long), besides the main supply line, is also provided, as a stand-by arrangement.

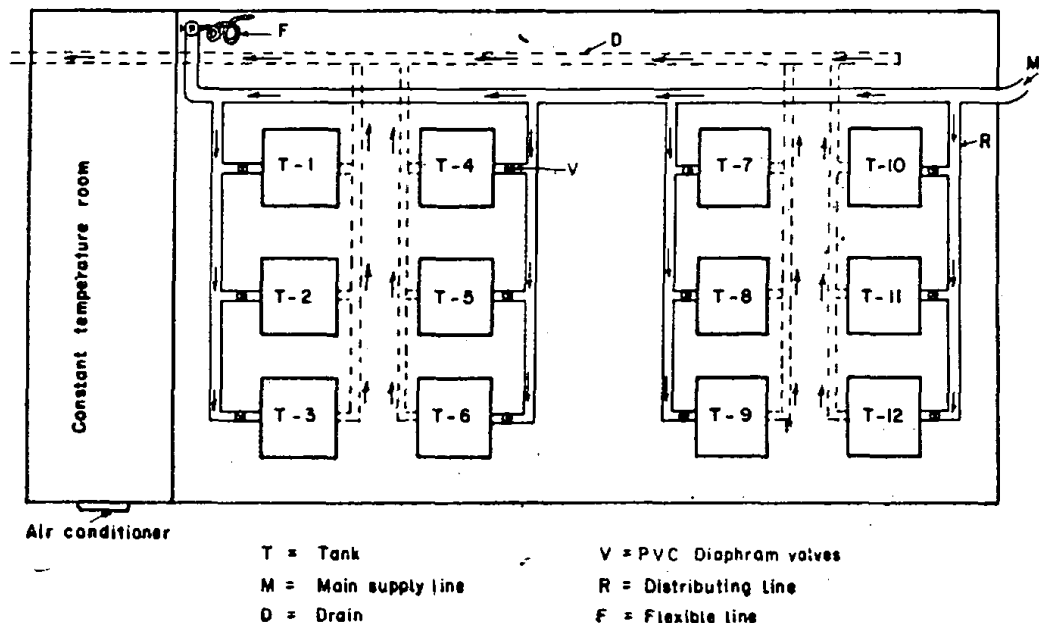


Fig. 3. Internal floor plan of the aquaculture laboratory.

Circulating System: Sea water, pumped directly from the sea flows into the settling tank at the rate of 4500 litres/minute. The water is allowed to remain in this tank for 24 hrs., for settling, mainly of suspended matter which is removed regularly through the outlet valves. The flow from settling tank to overhead tank is regulated through a diaphragm valve. Once the overhead tank is filled, the valve is closed and the settling tank is refilled by switching on the pump. The total requirement of sea water is estimated to be 50,000 to 55,000 litres/day. Hence, the pump is operated for 50 minutes, every alternate day.

The flow of sea water to each of the tank can be regulated through the diaphragm valve inside the laboratory but the normal flow rate is maintained at 180 litres/hour. The diameter of the inlet and outlet pipe being same, the quantity (870 litres) of water in each of the tank can be maintained satisfactorily. The drained-off water from the circulating system flows through an open cement gutter to the outside and then to a soak-pit. However, it is proposed to recirculate the sea water after proper filtration and settlement in a recirculating tank.

Advantages and Disadvantages: As the water is directly pumped from the sea and circulated without considerable loss of time through closed conduits, the normal physico-chemical properties of water remained unaltered. A study carried out on the growth of green mussels (*Perna viridis* L.) reared in aquaculture tanks has shown that the rate of growth was more than that in the natural mussel beds and comparable with that achieved under off-bottom culture on floating raft. Similarly, as each of the tank has controlled inlet and outlet of water, the spread of water-borne infections, could, considerably, be controlled.

The most obvious disadvantage is the break-down in pump, resulting in the total failure of the circulating system. Under such circumstances, heavy mortality has been observed due to stagnation of waters in the tank. The considerable lowering of salinity of the pumped sea water, especially during the heavy southwest monsoon precipitation (June–September) adversely affects the phytoplankton cultures, which are rather very sensitive to even small changes in the salinity of medium. The remedial measures, in the form of storing high salinity water in a separate tank during peak summer months of April–May and circulating it with gradual dilution with the freshly pumped sea water, are proposed.

Future Plans: The circulating system, in operation is of an open type and hence, has the above mentioned disadvantages. As elaborately discussed by Currie, Blaxter and Joyce (1976) the closed type of recirculating system is most appropriate for undertaking studies on aut-and synecology—as carried out in the aquaculture laboratory.

The first requisite for making a closed recirculating system will be the construction of a suitable reservoir of more than 1,00,000 litres capacity. The reservoir will be connected to the main outlet drain, through a stationery screen assembly (Fig. 4). The assembly will have a mechanized filter with replaceable screen of desirable mesh size and a manually rotating screen, partially

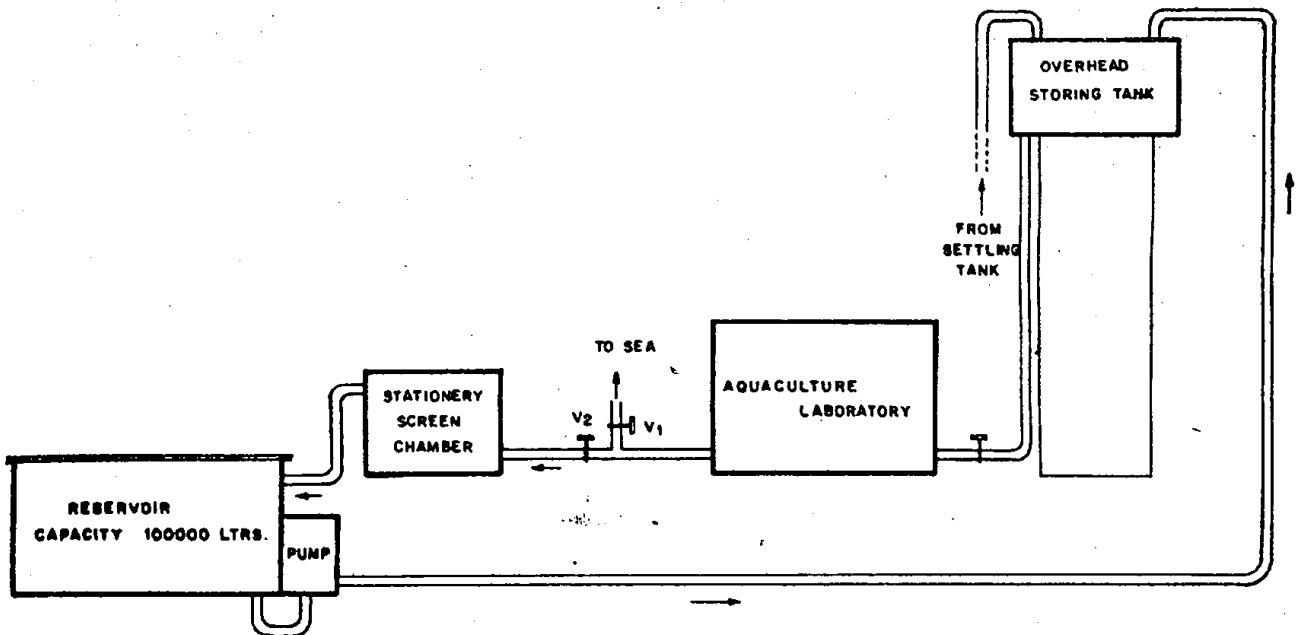


Fig. 4. Plan of the proposed recirculating system.

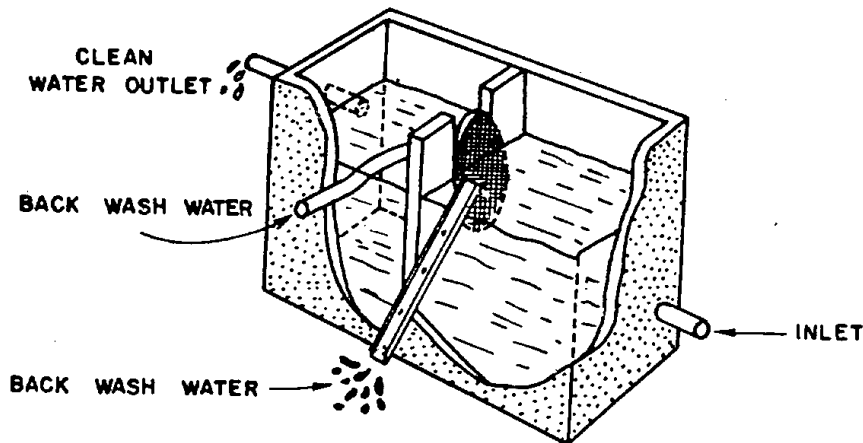


Fig. 5. Stationery screen.

submerged in the path of the outlet drain. The manual rotation will suck the suspended solids from the water. The filtrate can be removed by a simple device (Fig. 5) of forcing water through the screen in the reverse direction.

The water from the reservoir to the overhead tank will be pumped by a 7.5 HP polypropylene centrifugal pump (Fig. 4). After implementing the proposed modification, it will be possible to operate both closed as well as open system, simultaneously. It is also proposed to install a 15 HP centrifugal pump as a stand-by arrangement.

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