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Introduce the structure of the Water filter solutions in boat pumping station to water for aquaculture of Ca Mau Peninsula

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Abtract:

Saltwater provided for aquaculture in a CA Mau Peninsula area normally is taken from natural channels or rivers, water resources quality was affected by spoiled surrounding environment. So that, it is very difficult to control deals and product reduction.

In order to treat water resources before providing for aquaculture farms, people there use sediment ponds. However, due to the requirement of the sedimentation area of 20% ~ 30% of the cultivated area, many households have to reduce sedimentation pond area leading to low productivity.

This article introduces a water filtration solution located on the boat pump station and the results of the modeling experiments to supply water for aquaculture and can be applied to other areas in the Delta Cuu Long River (Mekong Delta). This solution can replace/reduce the sedimentation area, it is highly mobile, easy to apply to small farming areas in the Mekong Delta.

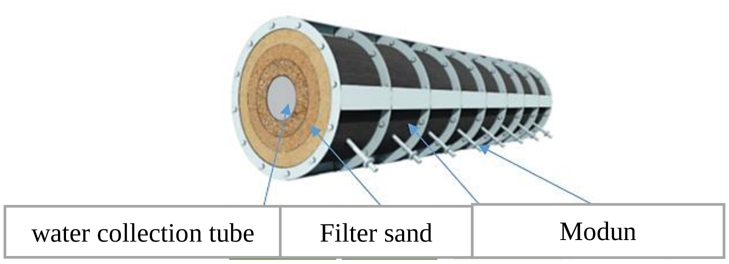


Figure 1: Water filter on the float [1]

Keywords: water supply for aquaculture, water filter, moveable pumping station, clean salt water resources

1. Introduction

Boat pump model is a model of floating buoys to filter the water and collect fresh water for the pond.

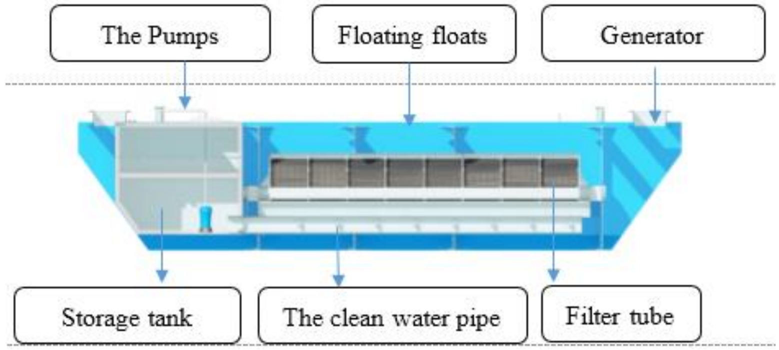


Figure 2: Model of boat pump station

In the research results of the research project " Water supply solution for aquaculture in Ca Mau Peninsula'', the research team has proposed the creation of a new long structure filter on floating floats to supply water for aquaculture (Figure 2). Each filter module of length L obtained the flow according to the results of the experimental study presented in this paper.

Filter tube with an outer D900 diameter, D300 diameter core. Perforated core tube with 20% opening, hole diameter d = 4 mm. Between the outer tube and the core tube, the layers of sand are filtered with a gradual grading, ensuring that the diameter of the layer close to the core is not penetrated by d = 4mm. The perforated core tube is sandwiched (4-6) mm, followed by layers 2-4 mm (close to the perforated tube is (1-2) mm and finally applying 10 cm to each layer to form a 30 cm thick concentric filter tube.

The filter module is submerged in water with a depth from the water surface to the center of the hull H. Water (chisel) from the surrounding environment permeates through the multi-layer sand filter into the core with Q flow according to the principle of slow filtration. According to the laws of physics, filter flow depends on the depth of the water column H. However, the quality of water through the filter depends on the velocity penetration through the filter layer, high permeability velocity is poor filter quality and vice versa. The purpose of this study was to find suitable flow rates for filtered quality to meet the requirements for aquaculture (concentration of alluvial sediment <100 mg / l [2]).

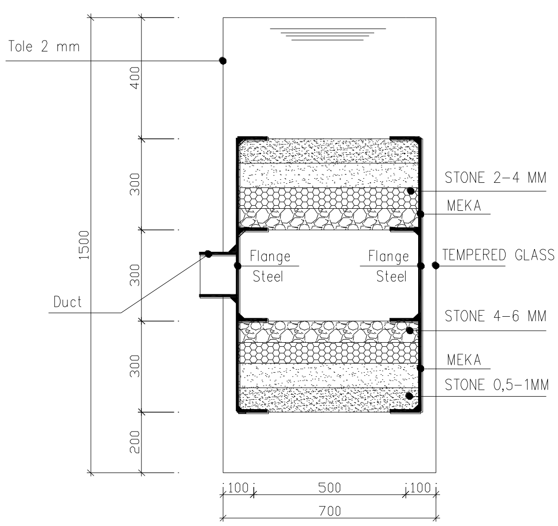


Figure 3: Diagram of filter tube used in research

2.Materials and methods

Figure 4 describes the experimental system consisting of three main tanks. The first tank to pump into the experimental tank. Alluvial sediment concentrations in the study strip were generated by weighing the sludge at each experiment.

The third tank to store filtered water, each of the experimental scenarios will take water samples for experimentation and visual observation. Water flow from the current filter for the tank through a van can be adjust the volume by request.

Experiment tanks were large enough to accommodate the filter, and at the same time the mouth was overflowed to maintain consistent water depth throughout the experiment. In addition, the space around the filter should be large enough to not affect the results of the experiment. In this study, the smallest size was over 20cm. Depth H may also vary, but in actual conditions, this study only changes within less than 1m.

The filter rotated during the experiment. The purpose is to simulate how to clean the filter when required.

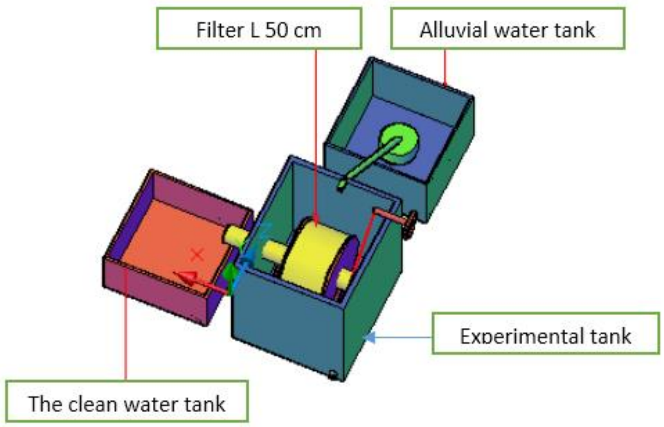


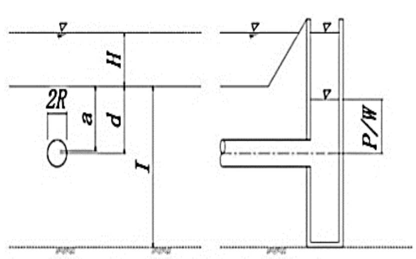
Figure 4**:** Three experimental tanks system

3. Results and discussion

3.1 Experiment with three layers of dress sand by hand

In this experiment, the filter tube was set at maximum flooding, the external sediment content was 300 g / m3.

The maximum capacity of the water intake is Q1 (according to equation 1).



$$Q = \varphi \varepsilon \omega \sqrt{2gH_0} \quad \text{Eq. 1}$$

Figure 5: Flow chart of water intake of the filter [3]

Based on the equation 1, biggest filtering capabilities:

$$Q_1 = 0,5*0,6*\pi*0,15^2*\sqrt{2g*0,5} = 140\frac{m^3}{h}$$

$$\rightarrow V_1 = \frac{Q_1}{\omega_1} = 0,55m/s \rightarrow [\omega]_1 = \frac{\omega_1*[v]_1}{v} = 12,8cm^2$$

However, the flow velocity in the above filtration layer is much higher than the allowed condition without disturbing the filter layers. Water quality is almost opaque. Therefore, it is necessary to control the flow to achieve a condition $[V]_1$ <1 cm / s (Table 1) in order not to disturb the filter by reducing water intake area to the point, as the request $[\omega]_1$ <12.8 cm2.

Table 1: Limiting velocities cause turbulence

Gravel sand	Small Sand	Average Sand	Big Sand
Diameter (mm)	0,05-0,25	025-0,5	0,65-2
Limiting velocity (cm/s)	1-1,5	1,5-1,7	1,7-3,7

3.2 V_1 control experiment to improve filter quality

From the condition of < 12,8 cm^2, choose the two D38 tubes and the D28 tube to continue the experiment.Measurement of flow in two cases of D38 and D28 shows the dependency of water column H according to the curve shown in Figure 5. In the working water column (estimated H = 60cm), the difference between the formula (1) is about 20%, namely:

$$Q_{D38}^{lt} = 9\frac{m^3}{h}; Q_{D38}^{tt} = 7,5\frac{m^3}{h}$$
$$Q_{D28}^{lt} = 5\frac{m^3}{h}; Q_{D28}^{tt} = 4\frac{m^3}{h}$$

Inside:

Qlt: Flow calculated by formula (1);

Qtt: flow measurement;

Based on the graph in Figure 7 the research team found that the ability to get the core D28 should be approximately 4m3 / h and D38 should be 7.5 m3 / h with water column H $\geq$ 50 cm while velocity Boot Campaign material is V= 0.3 cm / s & 0.7 cm / s <$[V]_1$.

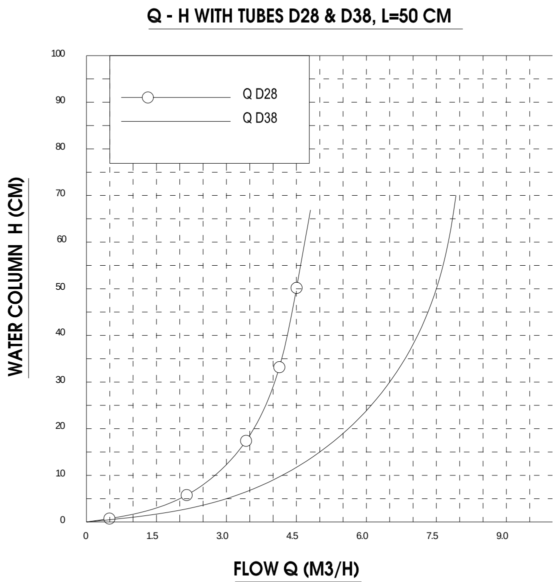


Figure 6: Q ~ H relationship through experiment

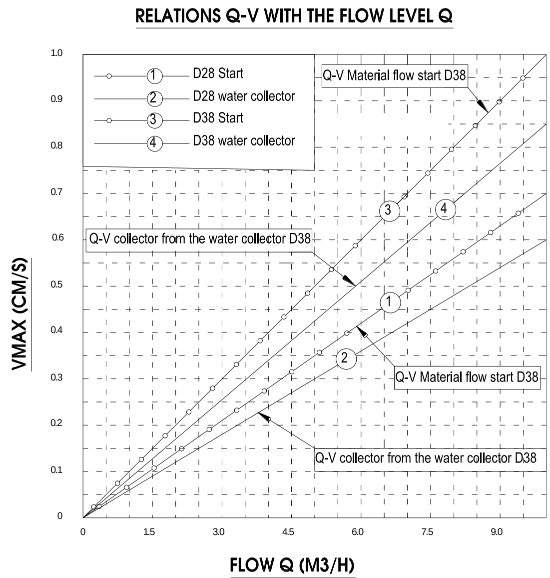


Figure 7: The TH1 physical speed boot the physical and the test.

With flow Q = 4 m 3 / h (tube D28), the team took water for testing. The result of water quality through turbidity is 91 mg / l <[requirement = 100 mg / l]. The test certificate is shown in Table 2.Similarly, with D38, Q = 7.5 m3 / h, turbidity is 103 mg / l, as satisfactory (see Table 2).

Table 2: Summary results calculation

STT	EXPERIMENTAL	EXPERIMENTAL METHODS	INPUT	OUTPUT	RESULTS
			TSS (mg/l)	Q (m3/h)	TSS (mg/l)
1	Turbidity (TSS)	TCVN 4560:1988	165	4	91
2				7,5	103

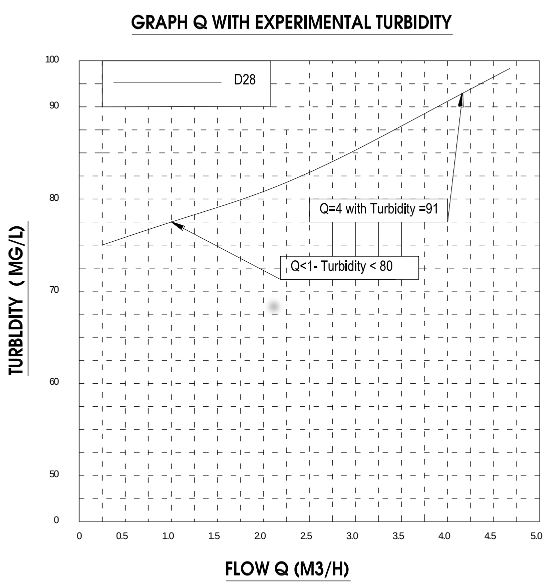


Figure 8: Relationship between Q and turbidity TH1

Experimenting with different levels of Q, the research team constructed a relationship between Q and turbidity. From Figure 8, the team found that in order to achieve a safe turbidity (<80 mg / l), three layers of the filter as above and compress the sand by hand are difficult to achieve. If acceptable to reduce the flow to Q <1 m^3/h, turbidity can be achieved. However, this does not guarantee economic conditions for the requirement of the project with a capacity of 50 m^3/h, then a filter core of up to 25m would be needed.

One of the important factors affecting the permeability velocity is the K coefficient and the number of filter layers. The research team recommends adding 1 layer of material and compacting as tight as possible to control permeability.

***3.*3Experiment with 4 layers of lagoon filter with K = 0.95**

3.3.1 Recreate the core filter model

Filter core is improved with full width and opening of D300 & D900, add one layer of sand 0.5-1 mm, the parameters for 4 layers of filter include: sand layer (4-6) mm thickness 7 cm, sand layer (2-4) mm thickness 7 cm, followed by sand layer (1-2) mm thickness 8 cm and finally sand layer (0,5-1) mm thickness 8 cm. The experimental water column H = 50 cm and collect water with a 28 mm diameter pipe.

In order to achieve sand filtering structures, select a height of 10cm for each of the five times to achieve a height of 50 cm with a relatively tight K95. The compaction process is divided into 5 times as follows:

- Sand the sand into the formwork and pump the water to reach the height of H = 10 cm. Using a vibrating sieve for the steel plant about 5cm, compacted with a density of about 10 times / 0.02 m2 surface area of the layer.

- Then use concrete dress directly to smooth the face

- Submersible sand filter soaked in filter for 1 hour, measured subsidence height and recorded data

- Continue to pour the layers of material calculated, and at the same time pumping water up against the old layer of 10 cm

- Dress and soak the filter for 1 hour for each dress.

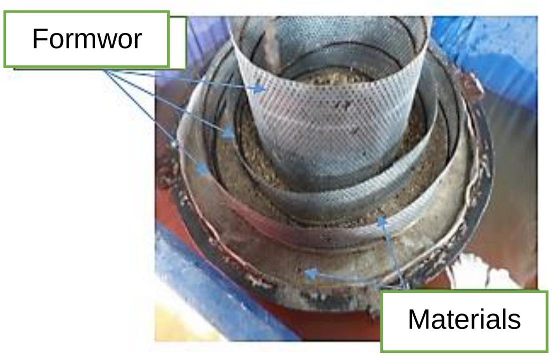


Figure 9: Filtration of 10 cm layer of filter soaked in water

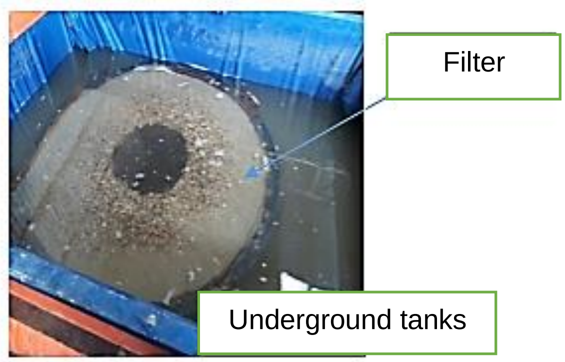


Figure 10: Model after lagoon and soak overnight

3.3.2 Results of calculations and experiments for four compaction layers

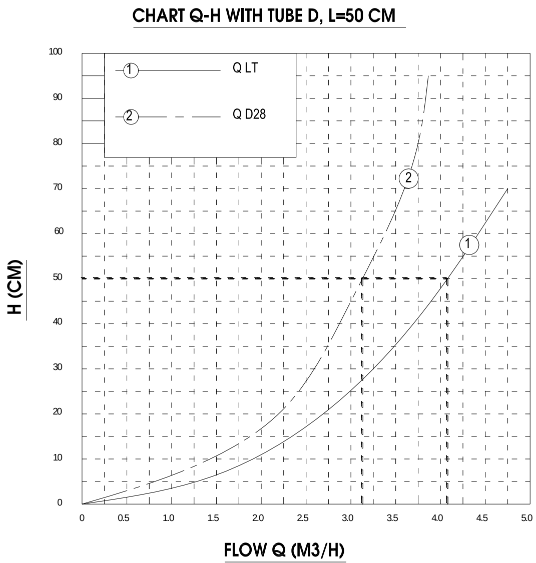


Figure 11: Q-H relationship with 4 coats of compacted core

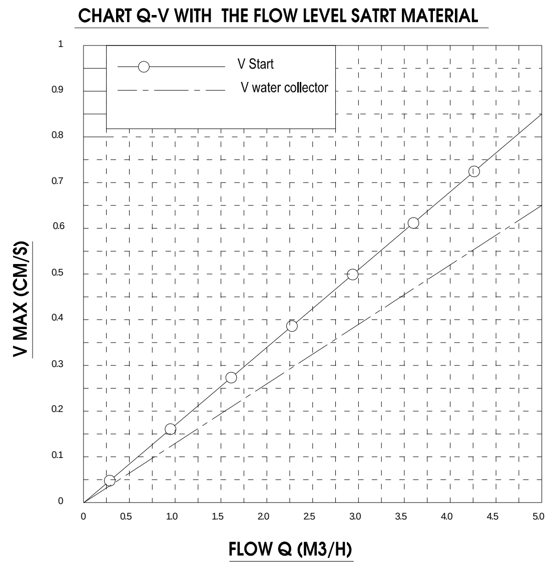


Figure 12**:** Relationship Q – V

With varying levels of flow and water column H, the results obtained from the 4 layers of material have Q> 3 m3 / h; water column H> 50 cm; Starting material velocity V = 0.5 cm / s <[V] 2.

Experimenting with samples with multiple levels of Q yielded the turbidity results for the samples (Figure 13).

Figure 13: Visual quality evaluation output

When the water column H from H = 80cm to

H = 0 cm.

Figure 14**:** From left to right: input and output with Q = 5 m3 / h; 4 m3 / h; 3m3 / h.

Table 3:Alluvium concentration is 10 mg/l when q = 3 m3/h

Stt	**Experimental**	**Experimental methods**	**Input**	**Output**	**Results**
			TSS (mg/l)	Q (m3/h)	TSS (mg/l)
1	Turbidity (TSS)	TCVN 4560:1988	165	3	10

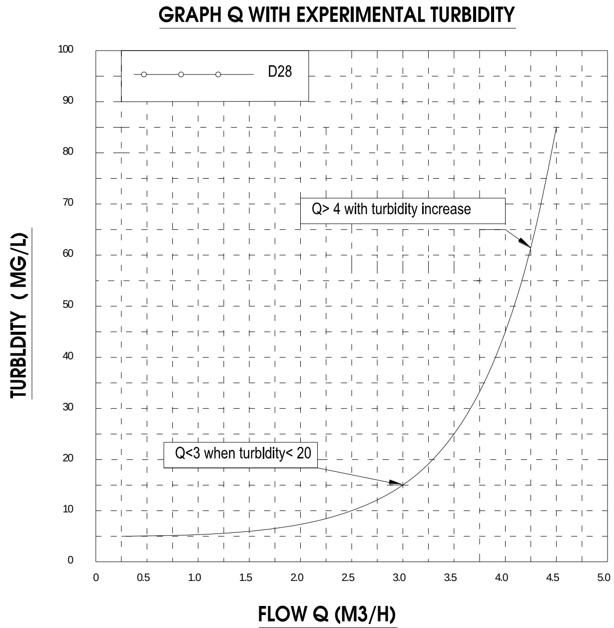


Figure 15 : Relation Q - turbidity with four compaction layers

Based on Figure 15, it was found that the effect was noticeable when Q increased the amount of alluvium that was rapidly increased when Q> 4m3. At the rate of Q <3 m3/h, the output of sediment is very small but the economic efficiency is not high.

The decision to choose Q = 3 m 3 / h, where the velocity through the filter core [V] = 0.5 cm / s <[V1] is suitable for turbidity and velocity not causing filter flutter.

4. Conclusion

The experimental parameters of the filter module for the design of the water supply pump for aquaculture in the Ca Mau peninsula are as follows:

The filtration system consists of a series of 50cm long filter modules placed on floats to provide water for aquaculture (shown Figure 1).

Filter tube with an outer D900 diameter, D300 diameter core.. Perforated core and core tube with aperture 20%, hole diameter d = 4 mm. Between the outer tube and the core tube, four layers of filter sand are added from the outside to the core, which is compacted and immersed in water to obtain a compacting factor of K = 0.95. The sequence is as follows: close to perforated core tube is sand layer 4-6 mm diameter 7cm thick, followed by layer 2-4 mm thickness 7cm, followed by layer 1-2mm thickness 7cm and finally (close with perforated tube) is 0.5-1mm thick 8cm. The thickness of each layer is 10 cm, forming a 30 cm thick concentric three-layer filter.

The filter is immersed in water with the water column H = 50 cm. (from the center of the pipe to the water surface)

Each module is 50cm long and allows the filter to be at least 3 m3 / h, the output water turbidity is <80 mg /l.

In addition, the filter structure according to research results can be used to filter river water during the flood season for domestic water supply.

5.Acknowledgments:

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