Standard Operating Procedure

The Conservation Fund's Freshwater Institute
Shepherdstown, WV

Title: Drum Filter Operation and Maintenance
Location: Growout System
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1. Purpose and Summary

Feces, biofloc and uneaten food can contribute to increased total suspended solids (TSS) within recirculating aquaculture systems. If not removed, solids can abrade the gill structure of fish and cause fish health issues. Additionally, organic acids from waste solids act as a nutrient source for bacteria and pathogenic organisms to thrive. One technique to control solids is a microscreen filter. Microscreen filters utilize fine mesh screens to exclude solids that are greater than the opening size of the screen media. During operation the screen media becomes plugged with solids. The plugged media causes the water level within the unit to rise. At the point of the high-water level set point the filter barrel will rotate while high pressure water sprays the solids away from the screens, and channels it away from the system. Microscreen filter media tends to biofoul quickly; therefore, proper maintenance is needed to keep the unit operating efficiently.

In the Growout RAS the microscreen filter is located next to the pump sump and radial flow settler (RFS) (**Figure 1**). Water flows into the drum and flows out through the screens. Clean water flows to the pump sump. Waste solids collect on the interior of the screens and cause the water level to rise until it activates a float switch that rotates the drum to spray the collected solids into the backwash tray for removal.

The purpose of this SOP is to describe the operation, maintenance, and troubleshooting procedures for the Growout RAS microscreen filter.

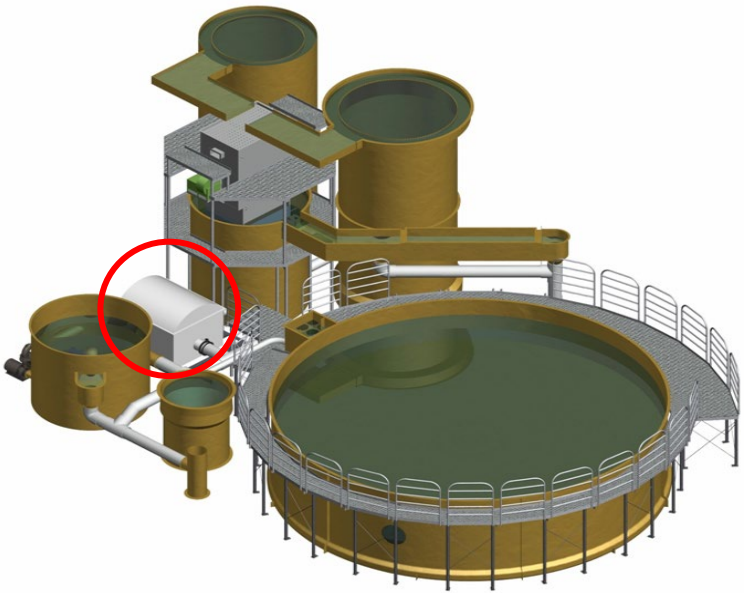

Figure 1. Growout RAS with microscreen drum filter indicated

2. Definitions

Backwashing - A process in which the interior drum rotates while pressurized water sprays solids off the screens to deposit captured solids in the backwash tray.

Backwash Tray - The channel located within the drum that captures the backwash.

Bypassing - The act of water flowing around the filter screens at the open end of the drum. This occurs when the filter screens are overloaded with solids, or through complete filter failure.

Float Cavity - Recess in the microscreen filter housing where the backwash-activating float switch is mounted.

Float Switch - An electrical switch used to monitor the level of water within the filter unit.

Lip Seal - Rubber strip along the bottom of the open drum that create a water-tight seal separating treated and untreated water.

Support Wheels - Wheels on either side of the drum frame on which the open end of the drum rests and rotates.

3. Health and Safety Warnings

Never work around a microscreen filter with loose clothing, hanging jewelry, or long hair. Objects caught on the rotating drum will be pulled into the filter unit and can cause serious injury or death. Always check that the microscreen filter is turned off while working on it or placing hands in the path of the drum. If doing work inside the filter unit working with a second person is recommended.

4. Personnel Qualifications and Responsibilities

Fish culture and facility operations staff trained and familiar with microscreen filter equipment can perform the procedures in this SOP. Staff should understand the operation and function of equipment listed in section 5.0.

5. Equipment

The microscreen filter consists of a filter housing, an interior drum, microscreens, gearbox, float switch, pressure pump, pressurized spray bar with nozzles, backwash collection tray, and control box. Regular maintenance requires the use of a power washer, hand tools, food grade grease, and gear lubrication oil.

6. Procedures

6.1 General Procedures

1. The microscreen filter can be bypassed when off-line or during general maintenance by opening the bypass valve to the pump sump and closing the inlet valve to the drum filter. Both bypass and inlet valves are large PVC butterfly valves with red and blue gear operators (**Figure 2**).

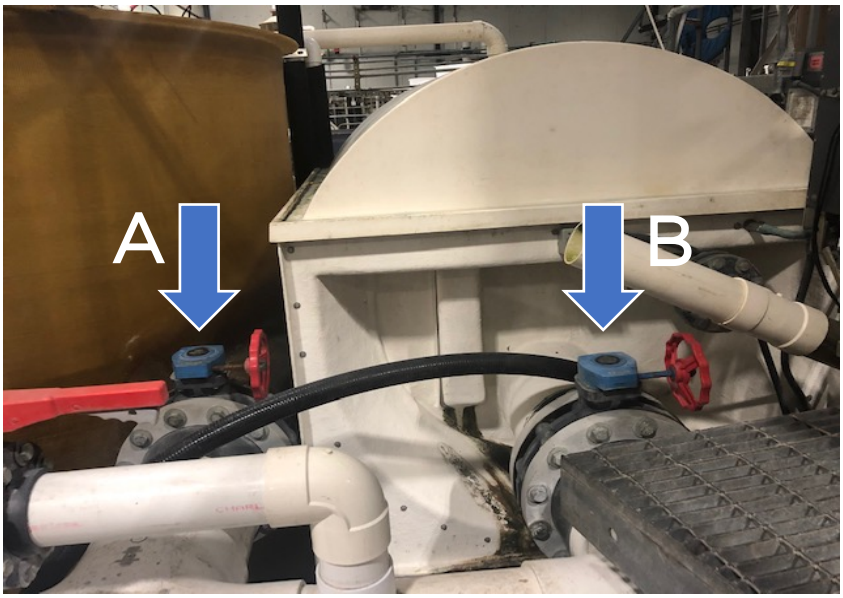

Figure 2. Valve to open bypass line to the sump (A) and valve to close drum filter inlet (B).

6.2 Daily Procedures

1. Check the microscreen filter for proper operation by visually observing a backwash event. Prior to a backwash event, the water level within the drum will increase, activating the float switch. Once activated, the interior drum will rotate and pressurized water from the spray bar will clean the screens. After approximately 15 seconds (depending on duration of time set at the time delay relay, goal is 1.5 or 2.5 drum rotations) the drum will stop rotating and return to its original state, at which point the water level within the drum will decrease. If you notice that the drum is not rotating or if it is bypassing water, notify the maintenance staff immediately to correct the problem to prevent solids from building up within the system.

2. Confirm that all spray nozzles are working properly and are not clogged during the drum filter backwash cycle (**Figure 3**). Each spray nozzle should produce an even fan pattern, but nozzle

orifices may become clogged by PVC shavings, calcium scale, or organic debris. Clogged nozzles prevent proper cleaning and cause more frequent backwashing. Nozzles not spraying properly should be disassembled and cleaned. When cleaning a clogged nozzle, make note of its position on the spray bar. Toggle the filter control selector switch into the OFF position to disable the drum from rotating and stop the flow of pressurized water to the spray bar. There is limited time to inspect and clean nozzles with the drum filter off, as solids will continue to enter the filter from the fish tank. It is recommended that spare nozzles assemblies be at the ready to replace clogged ones. After cleaning the clogged nozzle, toggle the selector switch to the HAND position to confirm it is spraying properly before returning the selector switch to AUTO.

3. Verify microscreen filter is not backwashing more often than expected. During normal operation the drum should remain idle for a period of two minutes or longer between backwash events. Continuous backwashing indicates that water entering drum is heavily laden with solids, filter screens need to be cleaned, and/or the backwash is not removing solids from the screens. If the filter does not backwash and the water level does not increase within the drum, then there may be holes in the screens, or a lip seal is worn. In either case, repairs should be performed immediately as solids are now passing into the pump sump and RAS components.

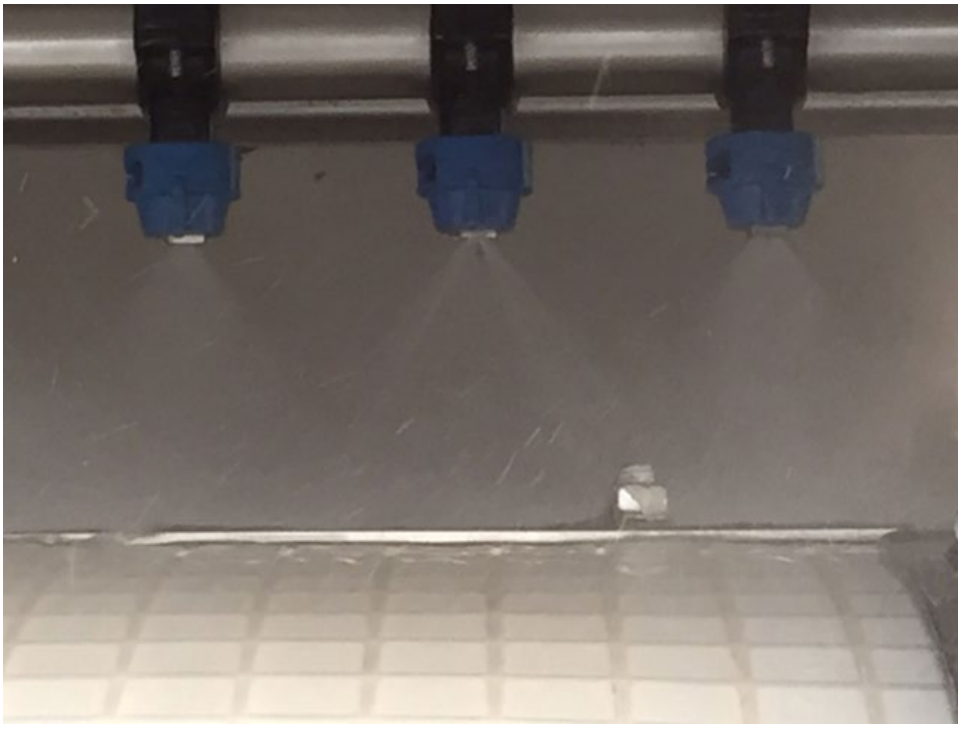

Figure 3. Spray nozzles operating normally during a filter backwash cycle.

6.3 Weekly Procedures

1. Filter screens foul over time. Clean the filter screens weekly using a power washer as follows:

    a. Connect the power washer to a water supply and power source and turn it on.
    b. Open the lid over the drum using the rope and pulley system. To lift the lid, start by grabbing the section of rope with the metal hook attached to the end, and walk with it to the upper LHO catwalk. Pull the rope towards your body, until the front of the lid has lifted approximately four feet off the filter base. Wrap the rope once around the railing on the LHO catwalk before hooking it to the catwalk floor. It is important to remember that the rope must be tight when hooking to the catwalk or the lid will slam shut (**Figure 4**).
    c. Turn the filter control selector switch to the HAND position to continuously rotate the drum (**Figure 5**) and turn the backwash header supply valve off to prevent excessive spray while the lid is up (**Figure 6**).
    d. Hold the power washer nozzle tip roughly a foot away from the screens to start and pull the trigger to start the power washer spray. Slowly move the nozzle closer to the screen until close enough to clean fouling, but not so close as to tear the screens. When doing this, orient the power washer spray to direct debris into the backwash tray in a similar orientation as the filter's spray bar nozzles. Hold the power washer nozzle in place on either end of the screen and allow the rotating screen to clean itself against the power washer nozzle. After one full rotation, move the wand an inch to right or left and repeat the process until the screen is completely clean. If holes form in the screen while power washing immediately stop – move the power washer nozzle further away from the screens (**Figure 7**).
    e. Spray the inside of the microscreen filter cover, as well as the frame, support wheels, and float cavity.
    f. Replace the filter lid when completely clean. Return the filter control selector switch to the AUTO position and open the spray bar supply header valve.
    g. Extreme caution should be exercised around the microscreen filter when the lid is open; the drum rotation will not stop if any item, inanimate or human, gets caught. In order to prevent accidents, individuals should refrain from standing on objects higher than the filter rim, wearing lose clothing, and holding the power washer wand too close to the drum.

Figure 4. Properly opened and secured drum filter cover

Figure 5. Drum filter control box. There is one HAND, OFF, and AUTO selector switch settings that controls both drum rotation and backwash spray.

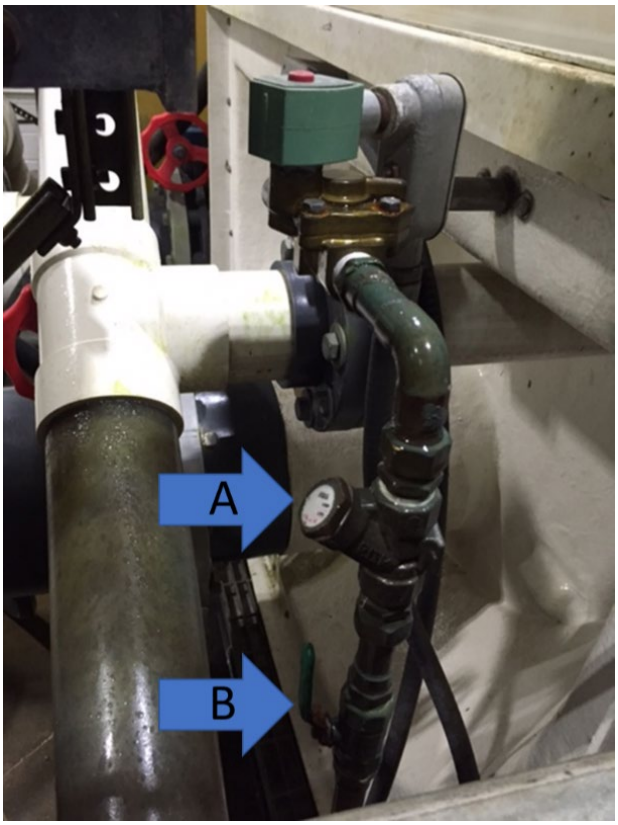

Figure 6. Spray bar strainer cover (A); Spray bar supply header valve (B)

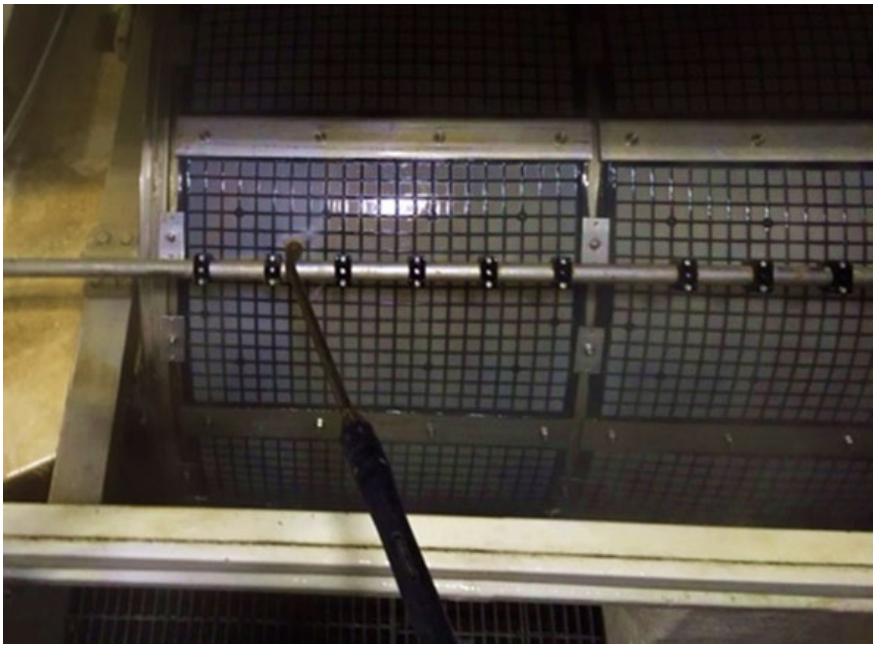

Figure 7. Example of a fouled screen being cleaned. Clean screen to the left has already been sprayed and fouled screen remains to the right.

2. Check that the filter spray nozzles are spraying properly and are not clogged. To clean clogged nozzles:

    a. Turn the filter control selector switch to the OFF position.
    b. Grab the blue nozzle, turn it 90 degrees counter clockwise, and pull it off the spray bar supply header. Be careful not to drop the nozzle, seal, or nozzle tip (Figure 8).
    c. Remove the nozzle tip and clear the clog by blowing or spraying the object out.
    d. Replace the nozzle tip and seal in the blue nozzle and press it back on the spray bar supply header and turn it to lock it in place.
    e. Turn the filter control selector switch back to the AUTO position.

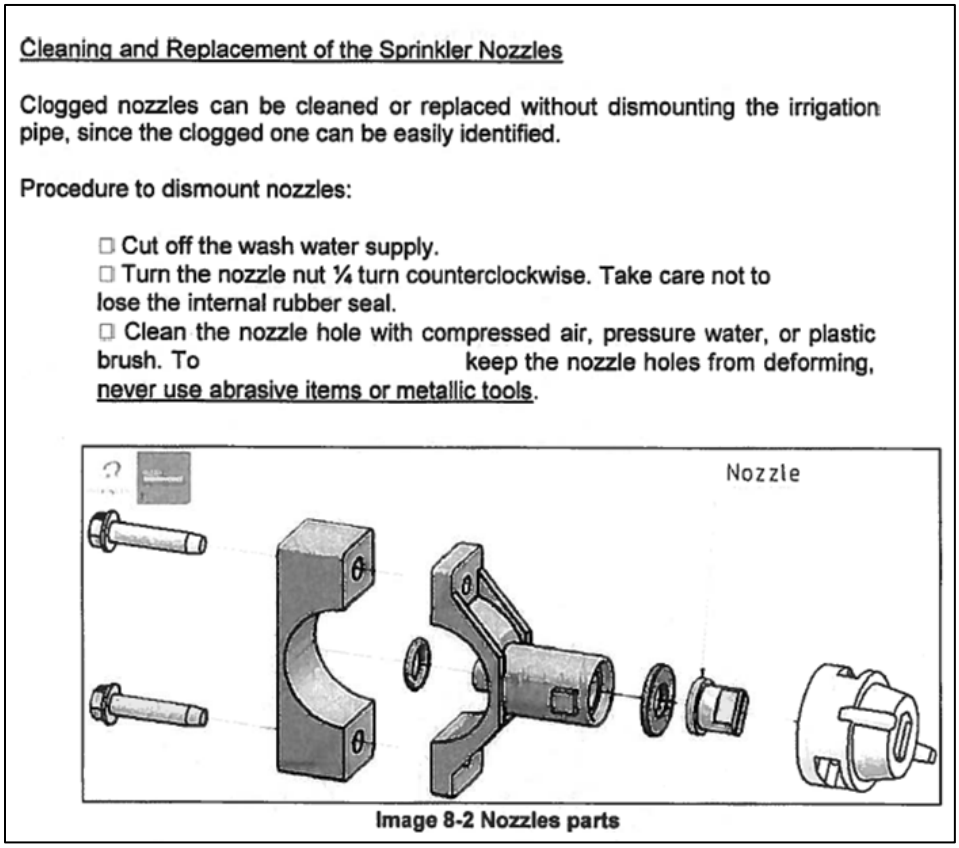

Figure 8. Procedure for cleaning a nozzle and exploded schematic.

6.4 Monthly Procedures

1. Check the screen for damage, holes, and tears. Damaged screens should be patched or replaced to maintain filter operational efficiency.

2. Check that the lip seal around the interior drum is intact. Water level will not rise inside the drum and solids will accumulate in the pump sump if the seal is not intact or damaged.
3. Grease both support wheels (**Figure 9**) via the grease ports at the end of the wheel supports using a food grade grease.
4. Clean the spray bar strainer filter (**Figure 6**).
   a. Turn off the spray bar supply header shut off valve.
   b. Open the cover on the spray bar supply header strainer with an adjustable wrench, taking care not to over torque the copper water line.
   c. Remove the filter and rinse off any debris with water. The filter may need to be briefly soaked in a calcium cleaner to remove any calcium scaling.
   d. Replace the filter, replace the filter cover and turn the spray bar supply header shut off valve back to the on position
   e. Pay close attention to the filter while the spray bar is off as the filter cannot backwash properly and may start to overflow.
5. Check the lubricant levels in the drum filter gear box. Lubricant should reach the max oil level and should be topped off if too low.
6. Check inventory of spare parts and order necessary equipment. Critical spare parts for the microscreen filter are the gear box, gear box motor, screens, lip seal, time delay relays, and backwash supply header solenoid valve.
7. Examine main control panel for signs of electrical problems or malfunctions.

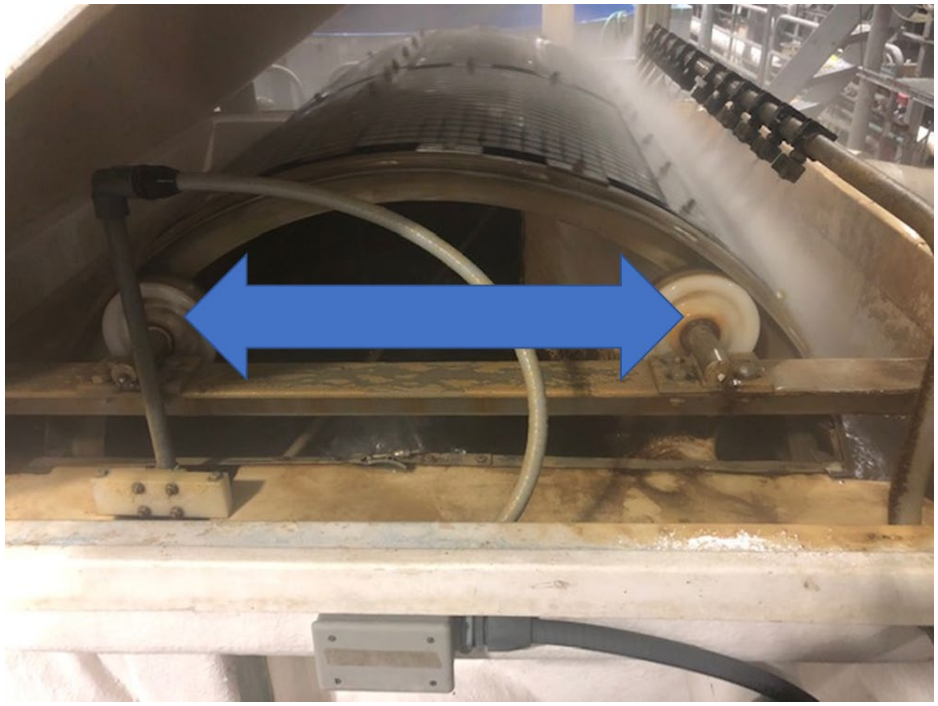

Figure 9. Drum filter support wheels indicated by the double-sided arrow.

6.5 Yearly Procedures

1. Between cohorts of fish, replace all filter screens with clean screens of the same mesh size. Dirty screens should be removed, soaked in calcium cleaner, and power washed before being reused. Filter screen panels are usually removed and soaked in calcium remover to dissolve mineral buildup every 12 months, regardless of screen condition.
2. Replace the old lip seal with a new one. Plan to do this while all the screens are off the drum filter. This is a dangerous task and requires entry into the filter housing. Motor breaker must be shut off and locked out before attempting.
3. Change gear box oil.
4. Check support wheels for wear on the tread and replace if needed.

7. Data and Records Management

Weekly cleaning should be recorded on the daily data sheet. Monthly backwash filter cleaning and lubrication checks should be recorded on the monthly maintenance sheet.

8. References

Microscreen filter and associated equipment manuals are in the 'Manuals' filing cabinet.

9. Troubleshooting