

WATER TREATMENT SYSTEM OPERATING PROCEDURES

1.0 INTRODUCTION

The following covers the operating procedures for the Water Treatment System used to treat carriage water from the dewatering process, decontamination water, and stormwater. The system consists of three (3) media filter and three (3) granulated activated carbon units and finally an effluent tank. This system is designed to treat liquid streams containing organic compounds. If these procedures are followed carefully, the system will be operated efficiently and safely.

The recommended operating procedures set forth in the manual are to suit normal operating conditions. Different conditions may require modifications of these operating practices. Since varying operating conditions may arise over the course of operation, the skill and judgment of the operating personnel should be exercised when needed.

These procedures will be available to operating personnel so that the operating instructions are followed. Only trained personnel should operate the system and perform maintenance.

2.0 STARTUP

The following sequence of steps will be followed to bring the water treatment system on-line in parallel mode:

1. Place the filter pump(s) in service to supply the system at the required flow and pressure.
2. Check that all the valves in the system are closed.
3. Start the primary pump and slowly open the valve in the influent line to one sand filter (V7, V8, or V9) and GAC filter (V13, V14, or V15). Allow pressure to increase to the operating level. Bleed air off through vent line.
4. Slowly open the valve in the influent line to the second sand filter (V7, V8, or V9) and second GAC filter (V13, V14, or V15). Allow pressure to increase to the operating level. Bleed air off through vent line.
5. Slowly open the valve in the influent line to the third sand filter (V7, V8, or V9) and third GAC filter (V13, V14, or V15), if required. Allow pressure to increase to the operating level. Bleed air off through vent line.
6. Open the valves in the effluent lines from the sand filters (V10, V11, and V12) and the GAC filters (V16, V17, and V18).
7. Open effluent valve (V19) from the effluent tank to allow discharge back into the river.

At this point, flow should be established through all vessels in parallel.

3.0 STEADY STATE OPERATION

Once flow is established to all vessels, no further adjustments are made during normal operation. The operator will establish a routine to check the vessels and to collect operating data. This data can be used to establish a maintenance schedule to determine when backwashing/backflushing is necessary.

Pressure gauges are provided on the influent and effluent lines of each vessel to determine the pressure drop. Taking periodic pressure readings (daily for the first week, weekly thereafter) will provide the operator with historic data for troubleshooting purposes. In the event the operating conditions change, the operator has the capability of taking corrective action.

All valves should be operated in a slow and even motion. Abrupt opening and closing of the valves can shock the system. Since complete shut-off of flow while a pump is operating could cause damage to the pump, the valves should be operated in the proper sequence to always maintain flow through the system. If the vessels are identified as PV1, PV2, and PV3 then the corresponding valve position during steady state operation are as follows:

Process Valve Number	Parallel Operation (PV1, PV2, PV3 and PV4, PV5, PV6)	Parallel Operation (PV1, PV2 and PV4, PV5)	Parallel Operation (PV2, PV3 and PV5, PV6)	Parallel Operation (PV1, PV3 and PV4, PV6)
V7	Open	Open	Closed	Open
V8	Open	Open	Open	Closed
V9	Open	Closed	Open	Open
V10	Open	Open	Closed	Open
V11	Open	Open	Open	Closed
V12	Open	Closed	Open	Open
V13	Open	Open	Closed	Open
V14	Open	Open	Open	Closed
V15	Open	Closed	Open	Open
V16	Open	Open	Closed	Open
V17	Open	Open	Open	Closed
V18	Open	Closed	Open	Open
V19	Open	Open	Open	Open
V20	Closed	Closed	Closed	Closed

V21	Closed	Closed	Closed	Closed
V22	Closed	Closed	Closed	Closed
V23	Closed	Closed	Closed	Closed
V24	Closed	Closed	Closed	Closed
V25	Closed	Closed	Closed	Closed
V26	Closed	Closed	Closed	Closed
V27	Closed	Closed	Closed	Closed
V28	Closed	Closed	Closed	Closed
V29	Closed	Closed	Closed	Closed
V30	Closed	Closed	Closed	Closed
V31	Closed	Closed	Closed	Closed
V32	Closed	Closed	Closed	Closed

TAKING VESSELS PV1 AND PV4 OFF-LINE

When vessels PV1 and PV4 are taken off-line for backwashing, maintenance, or flow conditions, all of the process flow will be sent through vessels PV2, PV3, PV5, and PV6 in the following sequence:

1. Close valve V16
2. Close valve V13
3. Close valve V10
4. Close valve V7

Flow will now be established through vessels PV2, PV3, PV5, and PV6 with vessels PV1 and PV4 off-line for backwashing.

PV1 AND PV4 BACK ON-LINE

After PV1 and PV4 are completely backwashed, they will be placed back on-line in the following sequence:

1. Open valve V7
2. Open valve V10
3. Open valve V13
4. Open valve V16

Flow will now be established through vessels PV1 and PV4.

TAKING VESSELS PV2 AND PV5 OFF-LINE

When vessels PV2 and PV5 are taken off-line for backwashing, maintenance, or flow conditions, all of the process flow will be sent through vessels PV1, PV3, PV4, and PV6 in the following sequence:

1. Close valve V17
2. Close valve V14
3. Close valve V11
4. Close valve V8

Flow will now be established through vessels PV1, PV3, PV4, and PV6 with vessels PV2 and PV5 off-line for backwashing.

PV2 AND PV5 BACK ON-LINE

After PV2 and PV5 are completely backwashed, they will be placed back on-line in the following sequence:

1. Open valve V8
2. Open valve V11
3. Open valve V14
4. Open valve V17

Flow will now be established through vessels PV2 and PV5.

TAKING VESSELS PV3 AND PV6 OFF-LINE

When vessels PV3 and PV6 are taken off-line for backwashing, maintenance, or flow conditions, all of the process flow will be sent through vessels PV1, PV2, PV4, and PV5 in the following sequence:

1. Close valve V18
2. Close valve V15
3. Close valve V12
4. Close valve V9

Flow will now be established through vessels PV1, PV2, PV4, and PV5 with vessels PV3 and PV6 off-line for backwashing.

PV3 AND PV6 BACK ON-LINE

After PV3 and PV6 are completely backwashed, they will be placed back on-line in the following sequence:

1. Open valve V9
2. Open valve V12
3. Open valve V15
4. Open valve V18

Flow will now be established through vessels PV3 and PV6.

4.0 SHUTDOWN

EMERGENCY SHUTDOWN

For emergency shutdowns, close all valves in the piping system, and open the vent line valves on each vessel. The primary pump should be shut down. Any drain valves in the pump casing should be opened for the duration of the shutdown.

SHORT TERM SHUTDOWN

For short duration shutdowns lasting less than one or two weeks, little needs to be done. Close all valves in the piping system, and open the vent line valves on each vessel. The primary pump should be shut down. Any drain valves in the pump casing should be opened for the duration of the shutdown. Freeze protection measures such as draining lines at the low points should be taken when there is a chance of freezing.

EXTENDED SHUTDOWN

For extended shutdowns, in addition to the steps described above, the vessels should be drained of all water and the media removed, sampled, and disposed of at the appropriate landfill.

5.0 BACKWASHING

In parallel operation, the influent flow is directed to all three vessels through a common inlet header. When backwashing becomes necessary, one vessel will be taken off-line as mentioned above. Differential pressure switches are supplied to measure the pressure drop across the inlet and outlet of each vessel. Pressure drop through each vessel is a function of many factors:

1. Pressure drop through the vessel media;
2. Piping pressure drop;
3. Flow rate, viscosity, and density of the liquid;
4. Solids build-up on top of the media;
5. Bacteria growth or chemical precipitation in the media;
6. Gas build-up in the media; and
7. Nozzle build up

Backwashing/backflushing is usually required when the pressure drop across any vessel increases by 5 to 10 psi during normal operation.

Backwashing and backflushing are procedures involving running clean, contaminant-free water up flow through the vessel. Backwashing or backflushing of the media can be done during operation to remove sediment from the top of the media.

The vessels should be backwashed prior to startup. The reasons for backwashing before placing vessels on-line are to: (1) size segregate the media so subsequent backwashing will return the media to the same relative position, (2) remove any air from the media, and (3) remove fine which can, in some cases, lead to excessive pressure drop and flow restriction.

Backwashing is done during operation to remove: (1) sediment from the top of the media, (2) fines that may be plugging the system, and (3) air that is binding in the media. The need to backwash is indicated by an increased in pressure drop.

Backwashing a vessel results in expanding the media, removing air, solids and fines, and classifying the particles. The backwash flow rate depends on the particle mesh size and the water temperature. Generally, rates in the range of 800-1200 gpm are sufficient to remove solids, remove air, and expand the media.

In this mode, a clean external source is used as the source for the backwash water. The following procedures will be followed:

1. Isolate the vessels to be backwashed by referencing section above titled "Taking vessel offline".
2. Open the backwash water outlet valve (V26 for vessel PV1, V25 for vessel PV2, V24 for vessel PV3, V32 for vessel PV4, V31 for vessel PV5, V30 for vessel PV6). Control valve with outlet valve.

3. Open the backwash water inlet valve (V23 for vessel PV1, V22 for vessel PV2, V21 for vessel PV3 V29 for vessel PV4, V28 for vessel PV5, V27 for vessel PV6), the backwash pump valve V20, and start the backwash pump.

The backwash water enters the vessel through the effluent line and flows up through the unit. The backwash water discharge from the backwash effluent should be observed for clarity to determine the duration of backwashing. Backwashing for a high pressure drop should take approximately 10 minutes. If excessive sediment and turbidity exists in the untreated water, the backwashing times may have to be increased to 15 minutes. A fresh media should be backwashed to classify the media. The time required for this step is approximately 30 minutes or until the backwash discharge is free of fines.

The valve sequence given below describes the steps taken to bring a vessel on-line after backwashing.

1. Shut off backwash pump and close valve V20.
2. Close the backwash water inlet valve (V21, V22, V23, V27, V28, or V29).
3. Close the backwash water outlet valve (V24, V25 V26, V30, V31 or V32).
4. Close the vent valve.
5. Open the vessel influent valve.
6. Open the vessel effluent valve.

6.0 OPERATION AND MAINTENANCE

At a minimum, maintenance of the vessels will be according to the manufacturer's recommendations. Vessels or components of vessels may be replaced if it is deemed prudent to maintain successful operation.