CABLE ADDRESS
"WATERFILT" PHILA.
Telex 831439

Roberts

FILTER MANUFACTURING COMPANY

P. O. BOX 167 • DARBY, PENNSYLVANIA 19023 • (215) 583-3131

OPERATION AND MAINTENANCE MANUAL

PRESSURE FILTERS
BUILDING 236

ROBERTS FILTER MANUFACTURING CO.

RFMCO CONTRACT 2093

CONTRACT #IFB N62470-82-B-2552

MANUAL VALVE SEQUENCE

OPERATION	☐ VALVE OPEN ☒ VALVE CLOSED																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
FILTERING		☒	☒								☒								
BACKWASH FILTER No. 1	☒			☒			☒	☒	☒	☒								☒	☒
BACKWASH FILTER No. 2	☒			☒	☒	☒			☒	☒								☒	☒
BACKWASH FILTER No. 3	☒			☒	☒	☒	☒	☒										☒	☒
EMPTY POOL		☒			☒		☒		☒									☒	☒

NOTES

1. DURING NORMAL OPERATION ADJUST V-1 TO PROVIDE 1200 GPM FLOW RATE AND ADJUST V-6, V-8 & V-10 TO PROVIDE EQUAL PRESSURE DROPS ACROSS FILTERS
2. ADJUST V-2 TO PROVIDE 1160 GPM FLOW RATE DURING BACKWASH
3. FILTERS TO BE BACKWASHED WHEN DIFFERENTIAL PRESSURE INCREASES 10 PSI FROM INITIAL DIFFERENTIAL

anthracite will be drawn into the plenum chamber. As described above, the release of "slugs" of air during backwash can upset the bed.

Additionally, introduction of the backwash water too suddenly or at too high a rate can be detrimental. Too low a backwash rate will not clean the media uniformly and will cause poor filter performance and permanent clogging of the bed.

3. Recommendations

Operators should frequently observe filters during backwash and note the following items:

a) Check for correct backwash rate.

b) Check for uniform backwash over entire bed surface (Gravity filters only).

c) Check that surface wash agitators are rotating. If not, some of the nozzles may be clogged. Consult the technical standard provided at the rear of this manual.

d) Check that the backwash time is long enough for proper bed cleaning.

e) If there is any evidence of air during backwash, investigate immediately.

NOTE If the rotating media agitators supplied by Roberts are of the air/water type, do not confuse the gentle, regular pattern of air bubbles produced by the unit with the often explosive release of air from the filter indicative of air being brought in by the backwash water.

Poor effluent quality, short filter runs and high head-losses are problems to be reported and investigated. These problems can be a result of a "dirty" filter due to the problems with the chemical feeds, insufficient backwashing and/or the nature of the material in the filter feed water.

Do not delay in investigating operating problems even though the effluent quality is acceptable. These problems will not go away and only result in serious malfunctions at a later and probably more critical time.

VIII. FILTER TROUBLE SHOOTING

Improper operation of a filter can result in significant treatment difficulties. Some of the more common occurrences are presented below. It is important that the plant operator be aware and avoid them if possible.

1. Filter Underdrains

Generally, the three (3) main causes of the failure of an underdrain are as follows:

A) Air in backwash water

B) Excessive solids build-up in the filter

C) Operating to an excessively high headloss

Evidence of "slugs" of air being released from the filter bed during backwash can not only damage the underdrain, if violent enough, but can cause the loss of filter media by carrying it to waste. Air can be introduced into the underdrain if the backwash header is permitted to drain between backwashes or it can be introduced by the backwash pump. Whatever the reason the cause should be corrected immediately.

If an excessive amount of solids is permitted to build up in the filter bed due to insufficient backwash flow or high carry-over of chemical precipitates or biologically active matter, portions of the filter bed can become permanently clogged. When this occurs, areas of high and low velocity are created in the filter bed during backwash.

Operating to an excessively high headloss can not only contribute to clogging of the filter bed but can produce a negative (below atmospheric) pressure. A negative head will cause air which is dissolved in the water to escape, resulting in air binding and the violent release of air during backwash. A negative head is rarely encountered in pressure filter systems.

2. Filter Beds

Upset of a filter bed is generally caused in one of two manners. If the underdrain has been damaged, the media gradation will be affected whereby gravel, sand and/or

Filter Shutdown

If it becomes necessary to remove a filter from service, it is suggested that the unit valves be closed to maintain the filter full of water.

For prolonged shutdown periods, it is suggested that the filter be kept full of water as above. Periodic backwashing with chlorinated washwater and/or the addition of a chlorine product to the filter to maintain a chlorine residual may be required to keep septicity of the filter bed to a minimum.

If a filter is removed from service and the water drained down below the top of the filter, refill the filter with backwash water only. DO NOT permit the filter to be returned to service by opening the influent valve since this will result in gross disturbances of the filter bed. When refilling a drained filter with backwash water, extreme care should be used. Gradually start the backwash water flow at a very low rate and do not increase the rate until all air entrapped in the bed has been released. Failure to maintain continuous control over filling the filter with water can result in permanent damage to filter underdrain as well as filter bed upset.

4) Slowly open the system backwash waste valves (V-3, V-11 and any other valves on the waste line from this system).

5) Very slowly open the system backwash inlet, regulating valve (V-2). While opening this valve close attention should be paid to the flow indicator.

NOTE: It is important that the backwash rate be gradually increased to the desired rate. Refer to Operating Data Sheet for recommended rates. Also note that increasing backwash water temperature will require higher flow rates to effectively clean the media bed. That is to say, that when the temperature of the backwash water increases, viscosity will decline requiring a subsequent increase in flow rate to suitably expand the bed.

CAUTION: Frequently check backwash waste for significant media carry-over and reduce flow as necessary.

6) After 7-10 minutes backwash is terminated on Filter No. 1 by closing valves V-5 and V-6.

7) To start backwash on Filter No. 2 open valve V-7.

8) Very slowly open the backwash inlet valve (V-8). While opening this valve, close attention should be paid to adjustments needed in V-2 to obtain the proper flow rate.

9) After 7-10 minutes terminate backwash on Filter No. 2 by closing valves V-7 and V-8.

10) The system is now ready to be put on line.

11) Close valves V-2 and V-3.

12) The waste water tank should be isolated by closing valve V-11. Open filtered supply to pool by opening valve V-18.

13) All of the filter inlet and outlet valves are opened. (V-5, V-7, V-9 and V-6, V-8, V-10).

14) The system service effluent valve (V-4) is opened.

15) Very slowly open the service inlet (V-1) to achieve the desired service flow rate.

NOTE: The service influent valves V-5, V-7, V-9 are also used for backwash waste outlets and service effluent valves V-6, V-8, V-10 are used for the backwash inlet.

III. DESCRIPTION OF OPERATION

Please refer to the Piping and Instrumentation Diagram (Drawing 6950-2) provided at the rear of this manual for a graphic representation of the information contained herein.

Service

The stream of water to be filtered flows through the inlet valve (V1), through the individual filter inlet valves (V-5, V-7, V-9) and is distributed over the surface of the media. As the water passes through the bed solid particles are trapped in the voids.

Cleansed water flows through the underdrain and exits the unit through the effluent valves (V-6, V-8, V-10).

As the filter bed becomes clogged, less water can pass through the bed unless the inlet pressure is increased. Eventually the filter will require backwashing. When the filter is sufficiently clogged the operator should begin the backwash sequence as described below.

IMPORTANT: In order to maintain the integrity of the filter beds and to allow for optimum filter performance, it is recommended that each unit be backwashed whenever any one of the following occurs:

1) 6-10 psig differential pressure is indicated
2) once every week
3) turbidity breakthrough occurs

Backwash

Each filter cell is backwashed separately and in sequence as follows:

1) Close the system effluent valves (V-18 & V-19).

2) Close the system influent valve (V-1).

3) Isolate the units not to be backwashed. Only one (1) filter (both cells) is to be washed at a time, therefore if Filter 1 is to be washed effluent valves (V-8 & V-10) should be closed followed by influent valves (V-7 & V-9).

II. OPERATING DATA SHEET

Number of Units:	Three (3)
Number of Compartments per Unit:	Two (2)
Size of Filter:	7' Diameter X 7' Straight Side
Design Pressure:	75 PSI W.P. ASME Code
Underdrain Type:	Header/Lateral
Filter Area:	38.5 Sq. Ft. per Compartment
Filter Flow:	400 GPM Each
Filter Rate:	5.19 GPM/SF
Backwash Flow:	1160 GPM
Backwash Rate:	15 GPM/SF
Backwash Time:	7 - 10 Minutes
Roberts Reference:	Camp LeJeune, North Carolina Contract 2093

Surface Wash – Washing or agitation of the media at the bed surface with high velocity streams of water and/or air to increase efficiency of solids removal from the media.

Suspended Solids – The amount of suspended particulate matter measured milligrams per liter (mg/l = ppm) determined by the filtration of a sample through a prepared glass-fiber filter or an asbestos lined crucible as specified by the latest edition of Standard Methods, (American Public Health Assoc.).

Underdrain – The filtered water collection system located beneath the filter media or media support gravel. This same system is also employed for distribution of backwash water. As the flow during backwash is generally 3 to 7 times that of service conditions, the hydraulic design of the underdrain system is governed by back-wash conditions.

Waste – The term generally applied to the water exiting the filter which contains the particulate material (floc or sludge) removed from the media during backwash.

has been in service for some time and the bed is filled with particulate material. Breakthrough, in this case, would indicate the termination of a run and the need to initiate backwash.

Effluent (filtrate) – The cleansed liquid that has passed through the filter.

Filter Media – The media which allows passage of filtrate (effluent) and retains the particulate material. Media is selected for desired physical characteristics; such as size, specific gravity, and gradation. For a particular application the filter media is specified in terms of "effective size" and "uniformity coefficient". Effective Size (E.S.) is defined as the size of the grain in millimeters, of which 90% of the material is larger. Uniformity Coefficient (U.C.) is calculated by determining the size of a grain of which 60% of the material is larger and dividing by the effective size.

The specific gravity of a media is also an important factor. Typical specific gravities are Silica Sand - 2.6, Anthracite - 1.5, Garnet - 4.2.

The size and depth of media are selected based upon experience or pilot plant studies for a particular or similar water.

Filter Run – The length of filter run (generally expressed in hours) between backwashings.

Filtration – The mechanical separation of suspended particulate matter from a liquid by means of pervious media.

Headloss – The pressure loss through a filter, measured between the inlet and effluent connections, generally expressed in feet of water for gravity units.

Influent (Feed) – The liquid fed to the filter.

Rate – The rate of filtration or backwash expressed in gallons per minute per square foot of filter surface area, generally abbreviated GPM/SF.

I. INTRODUCTION

The information and recommendations contained in this manual are offered to assist in operating, maintaining, and servicing the Roberts water filtration system and appurtenances for maximum efficiency in accordance with best accepted practice.

Equipment supplied under this contract is covered by the manufacturer's warranties regarding defective materials or workmanship. These instructions should be read and followed carefully, since errors in initial installation and operation might result in damage which would not be included in the warranties mentioned above.

A study of contents of this manual will also assist in understanding more clearly the operation of this plant. It is therefore an advantage if a copy of this manual be available for reference to persons directly responsible for operation and maintenance of the equipment.

DEFINITIONS

The terms used in these instructions are defined as follows:

Backwash – The reverse flow of water through the media to effect solids removal.

The rate of backwash water is often expressed in inches per minute rise. Each inch per minute (IPM) of rise equals 0.625 gallons per minute per square foot (GPM/SF); e.g. – 12 IPM rise = 7.5 GPM/SF.

When backwashing the filter the term "bed expansion" is sometimes used. This expresses the percentage of the original bed depth to which the bed is fluidized during backwashing. An expansion of 50% is normally considered maximum.

The degree of expansion is a function of the backwash rate, the size, shape and specific gravity of media, as well as the specific gravity and, to a great extent, the temperature of the backwash liquid.

Backwashing of filters is normally conducted from 3 to 10 minutes at rate of 15 to 20 GPM/SF.

Breakthrough – An expression used to describe the passage of suspended solids through a filter bed. This breakthrough phenomena most often occurs after the filter