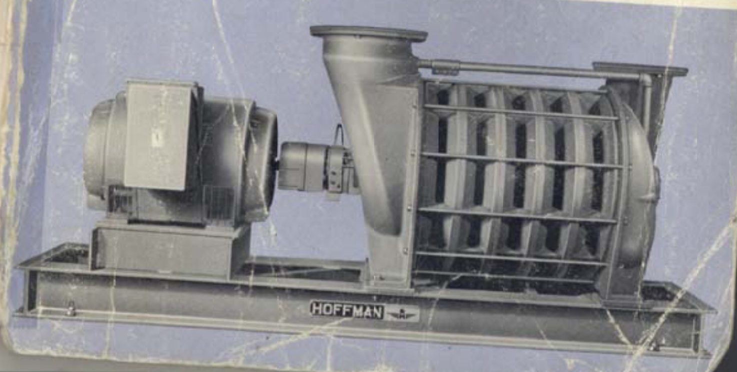
CENTRIFUGAL COMPRESSOR ENGINEERING

CENTRIFUGAL COMPRESSOR ENGINEERING



The air flow rate per diffuser will be:

$$\frac{356}{16} = \underline{22.3 \text{ SCFM/each}}$$

A typical aerated flocculation tank is shown in Figure 13-5.

Air-Water Backwash Systems

Air-water backwash systems have been adopted as an alternative to the employment of mechanical surface wash equipment. With this technique, air is injected through the filter underdrain system to break up mudballs as they rise through the filter. This technique has been used extensively on the continent.

One technique introduces the air above the underdrain plate as shown in Figure 13-6. The tendency of the air to float coal out of the filter has been eliminated by inserting a wire mesh orificing arrangement at the bottom of the wash trough to allow the filter water level to go to the bottom of the wash trough prior to the introduction of air to the filter.

The air-water technique applied in this manner would be as follows:

1. Stop influent feed to filter cell.
2. Lower level in cell to bottom of wash trough.
   a. The water level in the cell will reach that level by flowing up through the wire mesh orifice.
3. Apply air by itself at a rate of about 1-2 SCFM/sq. ft. filter area. (Note: Some systems require air feed rates of 2-5 SCFM/sq. ft.).
   a. Apply air only for a period of 3-8 minutes.
4. Turn off the air.
5. Open the backwash water feed and continue to backwash the filter at a rate of 15-20 gpm/sq. ft. (50% bed expansion), until the filter is clean.

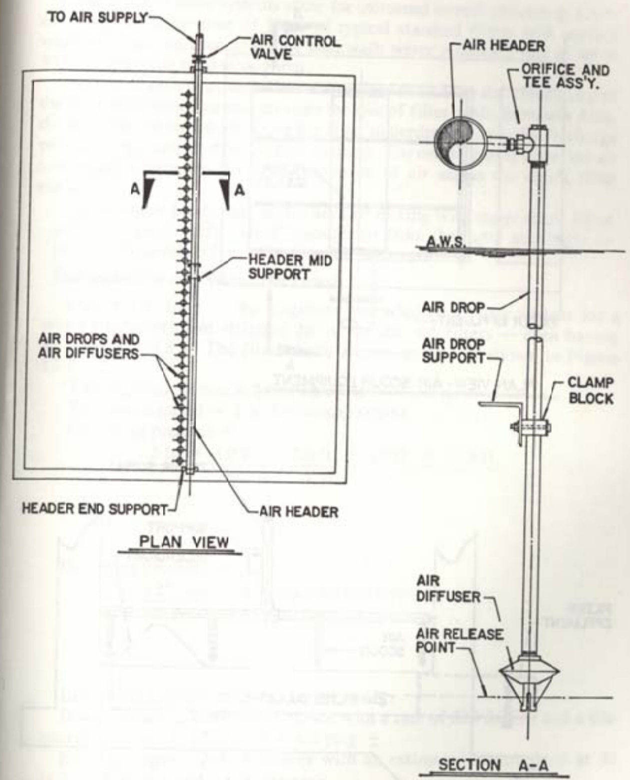


FIGURE 13-5 TYPICAL AERATED FLOCCULATION TANK ARRANGEMENT

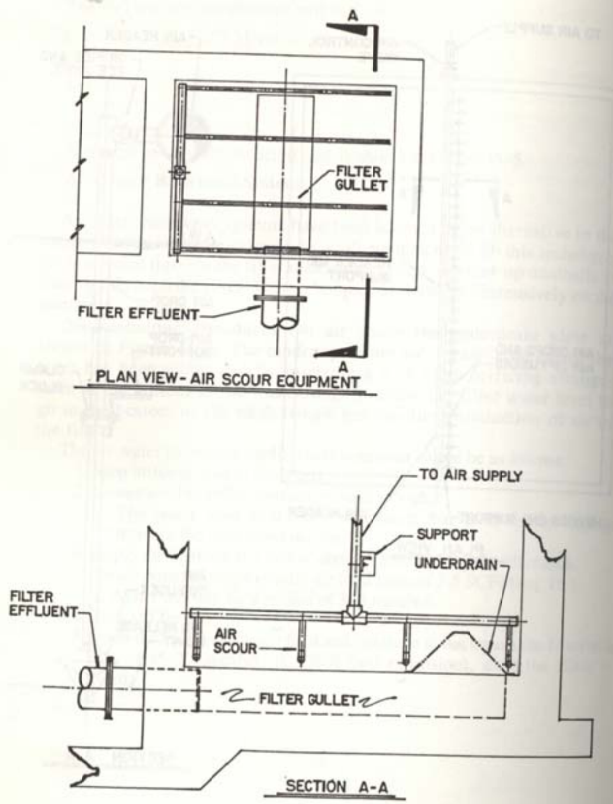


FIGURE 13-6 TYPICAL AIR-WATER BACKWASH FILTER ARRANGEMENT

These types of filter systems allow for increased overall efficiency. Owners report filtration runs of 150% of typical standard filters with surface wash units and an accompanying backwash water reduction rate of up to 35% ±, based on total throughput.

The use of system as described above does not add to the complexity of the backwash technique and prevents the risk of filter media blowout. Also, the introduction of the air above the filter underdrain lowers the discharge pressure requirement of the air feed systems. The coarse gravel above the air feed headers provides for even dispersion of air across the entire filter surface.

Many water plants that utilize aerated mixing with many small filter cells can temporarily "steal" enough air from the rapid mix basin to provide required air flows for air-water backwash.

Examples For Air-Water Backwash

EXAMPLE 12-5 — An Engineer has selected a filter system for a water treatment plant utilizing 20′-0″ × 20′-0″ filters — each having an area of 400 S.F. The filters have a cross-section as shown in Figure 13-7.

The required air-rate is 2 SCFM/sq. ft.
Total air required = 2 × 400 = 800 SCFM
Discharge pressure =

$$\frac{1.5\text{ ft.} + 1.0\text{ ft.} + 2.0\text{ ft.} + 1.0\text{ ft.} + 0.75\text{ ft.}}{2.31}$$

Discharge pressure =

$$\frac{6.25\text{ feet}}{2.31} = 2.7\text{ psig plus line losses}$$

Line losses usually run about 1.0 – 1.5 psig.

Design around a centrifugal blower with a rate of 800 SCFM and a discharge pressure of 2.7 + 1.5 = 4.2 psig ± .

Refer to Figure 12-4. A blower with an estimated motor sized at 30 H.P. will be required.

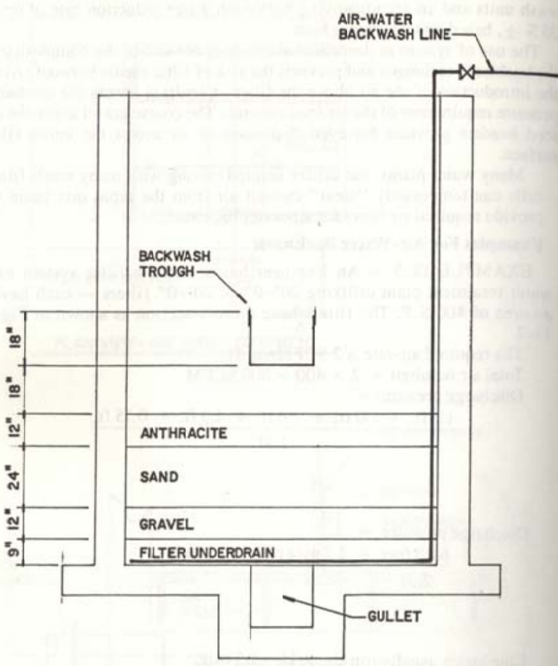


FIGURE 13-7 AIR WATER BACKWASH FILTER EXAMPLE

CHAPTER 14
DETAILED
AIR PIPING HEAD
LOSS CALCULATION PROCEDURES

Air Piping consists of the following components:

1. Discharge Check Valves
2. Discharge Control (Butterfly) Valves
3. Fittings (Bends, Wyes, Tees, etc.)
4. Meters (Orifices, etc.)
5. Inlet Filter Systems (Baghouses, etc.)
6. Inlet Control (Butterfly) Valves
7. Inlet Piping (Main)
8. Discharge Piping (Mains)
9. Pressure Relief Valves as required
10. Snubbers as required
11. Couplings, etc.

The two (2) types of air piping materials in current use which enjoy the most popularity are:

1. Ductile Iron or Cast Iron Pipe
2. Steel Pipe (hot dip galvanized after fabrication)

The piping is usually sized on a velocity basis. It should be sized such that the losses in the blower discharge mains, tank headers, and diffuser manifolds are small in comparison to the losses across the diffusers (orificing plus submergence).

Valves should be provided for flow regulation. They are typically of the quick opening-quick closing type, either butterfly valves or plug valves.

Typical air velocities (at standard conditions) are given in Table 14–1.

TABLE 14–1

TYPICAL AIR VELOCITIES IN BLOWER DISCHARGE PIPING

Pipe Diameter Inches	Velocity FPM — Std. Air
1– 3	1200 – 1800
4–10	1800 – 3000
12–24	2700 – 4000 *
30–60	3800 – 6500 *