Penn State **Extension**

Selecting a Faircloth Skimmer

Agricultural and Biological Engineering abe.psu.edu

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Based on the Skimmer developed and patented by J. Warren Faircloth
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Introduction

The skimmer described herein was developed and can be purchased from J. W. Faircloth and Son from Hillsborough, North Carolina. The skimmer is a sedimentation basin dewatering control device that withdraws water from near the basin's water surface, thus removing the highest quality water from the basin for delivery to the uncontrolled environment. The skimmer is shown in Figure 1. By properly selecting and sizing the skimmer, it will dewater a prescribed runoff volume in a prescribed dewatering period.

Skimmer Description

The skimmer consists of three primary parts; the "C" enclosure, the water entry unit, and the arm assembly. The "C" enclosure floats on the water surface and suspends the water entry unit just below the water surface. The arm assembly transports the water from the water entry unit to the basin's principal spillway barrel. Water discharge rate is controlled by the geometry of the skimmer and a carefully sized orifice located at the entrance to the arm assembly.

The "C" enclosure consists of a closed section of PVC pipe, including two end caps, four 90-degree elbows, three short sections of PVC pipe connecting the elbows and two very short PVC nipples connecting the end caps. All joints are solvent welded forming a water tight "C" enclosure which is buoyant causing the "C" enclosure to float on the water surface.

The "C" enclosure is connected to the horizontal, water entry unit by two flat aluminum plates connected to opposite sides of the "C" enclosure. These two aluminum straps extend below water level such that the water entry unit pivots below the water surface. This water entry unit, also made of PVC pipe sections, consists of two PVC end caps (connected to the aluminum straps by a stainless steel bolt) and two short perforated sections of PVC pipe each connected to a PVC tee in the center, which contains the flow control orifice. The perforations allow entry of all water to the orifice plate as it is discharged from the basin. The combination of the "C" enclosure and the perforated sections of the water entry unit help to keep floating trash and debris larger than about one-half inch in size from clogging the skimmer.

The arm assembly has three sections; a very short nipple of PVC pipe connecting the water entry unit's tee to a second vent tee, and the long section of the arm. This vent-tee vents the downstream side of the orifice to atmospheric pressure. The control orifice is drilled into the center of a plastic knock-out plug placed at the arm entrance. The details of sizing this orifice will be discussed later.

At the lower, discharge end of the arm, the arm is connected to a flexible hose, which permits free vertical and horizontal motion of the arm. The downstream end of the flexible hose should be connected to a short section of pipe mortared, or connected to the basin's principal spillway structure.

The Faircloth Skimmer

A Faircloth skimmer is shown in Figure 1. An orifice located just below the water surface controls the flow of water entering the skimmer and exiting the basin. The water is discharged from the arm assembly into the basin's barrel. It is assumed that the barrel is sized

to carry the skimmer's discharge as open channel flow. The Faircloth skimmer is available from J. W. Faircloth and Sons, Inc at (http://www.fairclothskimmer.com) in specific sizes (see Table 1). The skimmer size refers to the diameter of the float and arm. The Faircloth Skimmer should be sized by first determining the required (or desired) basin outflow rate. This means you must determine the volume of water, V to be dewatered from the basin in cubic feet (ft^3) and decide how many days you want the skimmer to take to remove this volume of water, the dewatering time, t_d. With these two requirements determined, compute the required outflow rate, Q (in cubic feet per day, ft^3/d) as

$$Q = \frac{V}{t_d} \qquad (1).$$

With the required outflow rate (in ft^3/day) known, select a skimmer and orifice (if needed) from the Selection Charts (see Table 1). The skimmer selection procedure is illustrated below and in an Example.

Skimmer Example: Select a skimmer that will dewater a 20,000 ft^3 skimmer basin in 3 days.

Solution: $Q = \frac{V}{t_d} = \frac{20000\,ft^3}{3d} = 6670\,ft^3/d$ rate as

Now go the Selection Charts (Table 1) and select an appropriate skimmer. If the 2-inch skimmer with no orifice is chosen, the outflow rate will be 5,429 ft^3/d, which will require about 3.5 days to dewater the basin. An alternative might be to use a 4-inch skimmer with a 2.5-inch diameter orifice, which will have an outflow rate of 8,181 ft^3/d and dewater the basin in about 2.5 days.

A More Precise Alternative: Each skimmer comes with a plastic plug that can be drilled forming a hole that will limit the skimmer's outflow to any desired rate. Thus, for a specific skimmer the orifice that will dewater a basin in a more precisely chosen time can be determined. The flow through an orifice can be computed in ft^3/d using the diameter D (in inches) and the head H (in feet) as

$$Q = 2310 D^2 \sqrt{H} \,. \qquad (2)$$

In the Example, if we solve the orifice equation, in the form of Equation 2, for the orifice diameter using the desired outflow rate (6670 ft^3/d) and the head driving water through the skimmer (0.333 ft for a

$$D = \sqrt{\frac{Q}{2310\sqrt{H}}} = \sqrt{\frac{6670}{2310\sqrt{0.333}}} = 2.24 inches$$

We see that if the plastic plug were drilled to a diameter of 2.24 inches and placed in a 4-inch skimmer,

Table 1. Faircloth Skimmer Selection Charts

1.5-inch skimmer (H = 0.125 ft)

Orifice (in)	Outflow Rate (ft^3/d)
None	2,079
1.0	809
0.5	193

2-inch skimmer (H = 0.167

Orifice (in)	Outflow Rate (ft^3/d)
None	5,429
1.0	924
0.5	231

2.5-inch skimmer (H = 0.167 ft)

Orifice (in)	Outflow Rate (ft^3/d)
None	9,548
1.0	1,039
0.5	250

3-inch skimmer (H = 0.25 ft)

Orifice (in)	Outflow Rate (ft^3/d)
None	10,588
1.5	2,541
1.0	1,136
0.5	289

4-inch skimmer (H = 0.333 ft)

Orifice (in)	Outflow Rate (ft^3/d)
None	16,863
2.5	8,181
2.0	5,236
1.5	2,945
1.0	1,309
0.5	327

5-inch skimmer (H = 0.333 ft)

Orifice (in)	Outflow Rate (ft^3/d)
None	26,276
3.5	16,035
3.0	11,781
2.5	8,181
2.0	5,236
1.5	3,715
1.0	1,309
0.5	327

6-inch skimmer (H = 0.417 ft)

Orifice (in)	Outflow Rate (ft^3/d)
None	44,371
4.5	29,645
4.0	23,427
3.5	17,941
3.0	13,186
2.5	9,144
2.0	5,852
1.5	3,292
1.0	1,463
0.5	366

8-inch skimmer (H = 0.5 ft)

Orifice (in)	Outflow Rate (ft^3/d)
None	127,416
5.5	48,510
5.0	40,098
4.5	32,475
4.0	25,660
3.5	19,654
3.0	14,438
2.5	10,029
2.0	6,410
1.5	3,619
1.0	1,598
0.5	404

Figure 1. Faircloth skimmer

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