Water Facts

Manitoba
Water Stewardship

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DUGOUT AND POND AERATION

Dec 1999

During winter, ice cover on dugouts prevents water from dissolving atmospheric oxygen. As a result, aerobic decomposition of dead organic material such as algae, animal and other plant life depletes the existing dissolved oxygen in the water.

Once the dissolved oxygen is used, anaerobic decomposition (decay without oxygen) takes place. During this process, carbon dioxide and hydrogen sulphide gases are produced. The hydrogen sulphide, which is odorous, reacts with the organic matter causing the water to become black and odorous, tainting the water quality. This is commonly called black dugout water. As well, low oxygen levels near the bottom of the dugout frequently cause the water to leach out nutrients from the bottom sediments back into the water column, even during summer months, causing the water quality to deteriorate and promoting further alga growth.

The deterioration of water quality in this manner occurs in a number of dugouts and ponds. Even those properly maintained and having a high oxygen content in the fall are likely to have little or no oxygen left by the end of the winter. This makes hydrogen sulphide production probable.

Aeration

Maintaining aerobic decomposition in water throughout the year can be achieved through the diffusion of atmospheric air into the water supply. This process, known as aeration, assures a sufficient level of dissolved oxygen entering the water supply to control odours and maintain good water quality. Aeration should be applied continuously to maintain good water quality and reduce alga growth.

Types of Aeration Systems

While there are a number of methods to circulate and mix air into the water, most are impractical for the weather conditions encountered on the prairies. Over the years, it has been found that the use of compressed air, properly diffused into the water column, produces the best results in dugouts. Diffused air is introduced into the dugout using a small compressor, feeder line (from compressor to the dugout bottom), and a distribution line (along bottom of dugout). There are two methods of feeder line installation - deep burial or shallow burial. Both are permanent installations.

Deep Burial Aeration Line Installation

Deep burial aeration systems require installation of a 12-mm (1/2 in.) feeder line to carry the air. The feeder line is buried with the water intake line about 2.5 m (8 ft.) deep. Deep burial aeration is recommended as the preferred method of aerating dugout water.

Steps

1. Determine the length of the feeder line (distance from the air compressor to the dugout flat bottom) and distribution lines (see Design Table). The distribution line should lie on the flat bottom area of the dugout (Fig. 1).

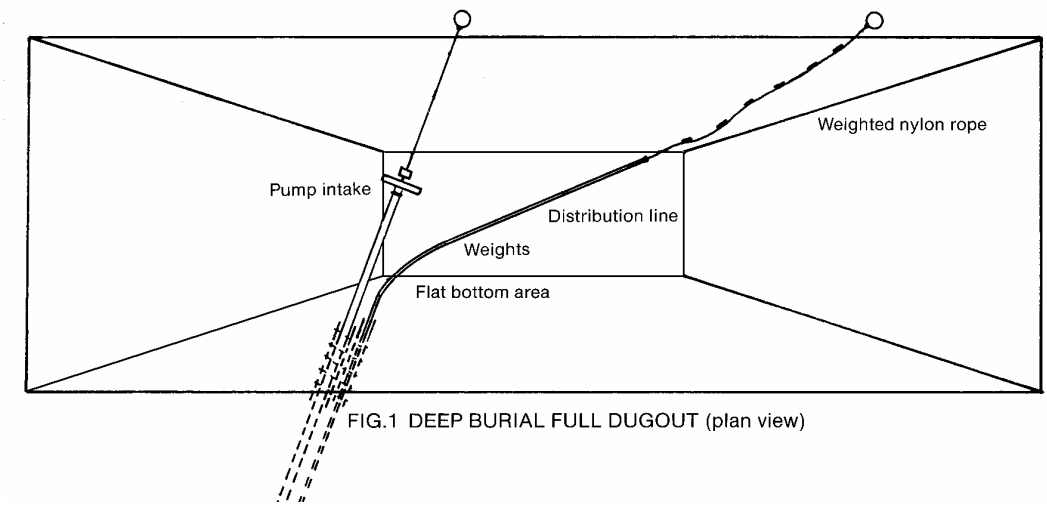


FIG.1 DEEP BURIAL FULL DUGOUT (plan view)

2. Construct concrete weight. (SEE NOTE BELOW ABOUT ALTERNATE WEIGHTS). A one-litre milk carton half filled with concrete will result in a 1 kg (2.2 lb.) weight. Imbed one end of a nylon rope or coated wire e.g. TWU #12 that is knotted and tied to a washer into the wet concrete (Fig. 3). The other end of the wire (AFTER CONCRETE HARDENS) is tied to the polyethylene pipe every 2 m (6 ft) and clamped, using stainless steel clamps (Fig. 2). Attach the weights as close as possible to the pipe.

NOTE: Scrap iron weights are not recommended as their irregular shape may catch in mud or damage the pipe. Rusting will also occur.

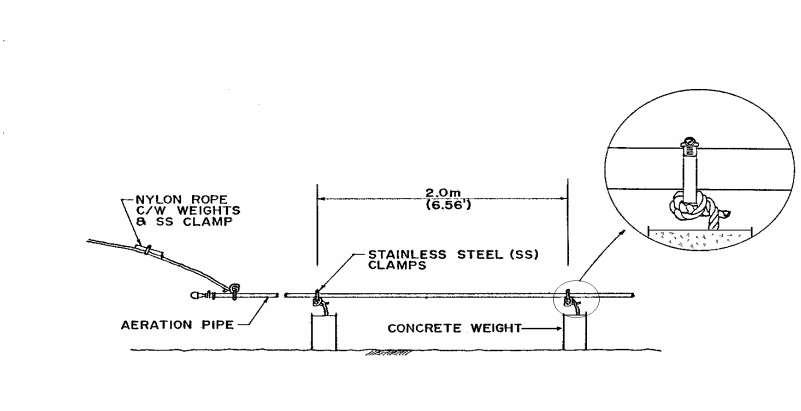


Fig. 2 Weight Attachment

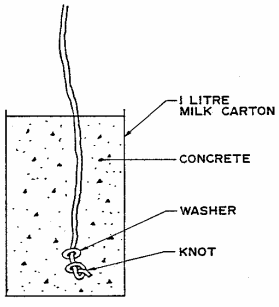


Fig. 3 Concrete Weight

3. The feeder line, made of 12mm (1/2 in.) polyethylene pipe, is placed parallel (no crossovers) to the pump suction line in the trench to the dugout edge.

4. Protective casing should be installed at the dugout edge were the pipe enters the dugout to prevent crimping of the hose. To do this, thread the feeder line through 6m (20 ft.) of 25 mm (1") diameter polyethylene pipe. Tie aeration line protective casing to the suction line protective casing (see **Floating Intakes for Dugouts and Ponds**).

5. Backfill cautiously and install the floating intake.

6. Select a compressor using the Design Table; drill 1.6 mm (1/16 in.) holes according to recommended numbers and spacing. Plug the end of the distribution line.

7. Attach the installation rope – eight mm (5/16 in.) nylon – by clamping it to the end of the distribution line. Attach small weights to prevent the rope from floating and being caught in ice.

8. Start the compressor, if available. Pull the remaining feeder and distribution lines into position. The distribution line should not interfere with the dugout float operation.

9. Slacken the rope and tie it to a permanent post on shore.

10. Please note that a check valve must be installed at the compressor. The check valve should be a spring loaded, all position type, capable of sealing air at very low backpressure. An example of an acceptable type is Ocean BT 500.

Shallow Burial Aeration Line Installations

The shallow burial method requires positioning the feeder line about 300 mm (12") below ground to prevent pipe damage. Normally, this system is used where trenching is not required since a water distribution system already exists. Check valve failure and/or condensation in the feeder line (see Shallow Burial Air Compressor Operation) can result in ice blockage of the feeder line during winter.

Steps

1. Determine the length of the feeder line (distance from air compressor to flat bottom area of dugout) and distribution lines (use Design Table). The distribution line must be located on the flat bottom area of the dugout.

2. Construct concrete weights (see step 2, Dugout Deep Burial Installation).

3. To prevent pipe damage, bury the feeder line a minimum of 300 mm (12").

4. Select a compressor using the Design Table; drill 1.6 mm (1/16 in.) holes according to recommended numbers and spacing. Plug the end of the distribution line.

5. Attach the installation rope (see step 8, Dugout Deep Burial Installation).

6. Install a check valve at the compressor to maintain air pressure in line and prevent water from backing up the pipe and causing freezing. The check valve should be a spring loaded, all position type, capable of sealing at very low backpressure. An example of an acceptable valve is the Ocean BT 500.

7. Start the compressor. Pull the remaining feeder and distribution lines into position. Insure the rope and pipe passes underneath the floating intake rope.

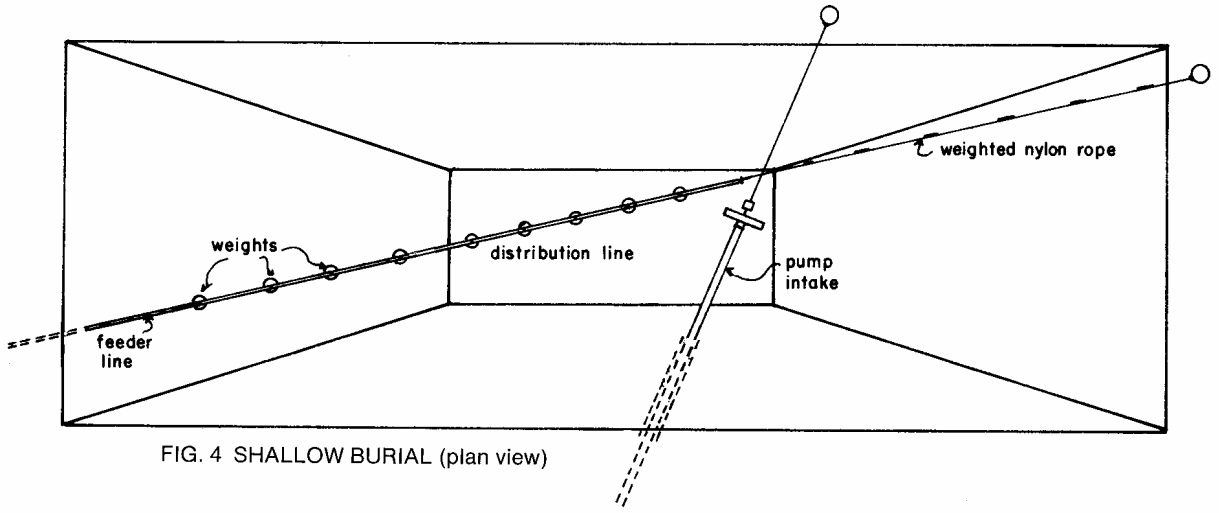


FIG. 4 SHALLOW BURIAL (plan view)

8. Slacken the rope and tie it to a permanent post on shore (Figure 5).

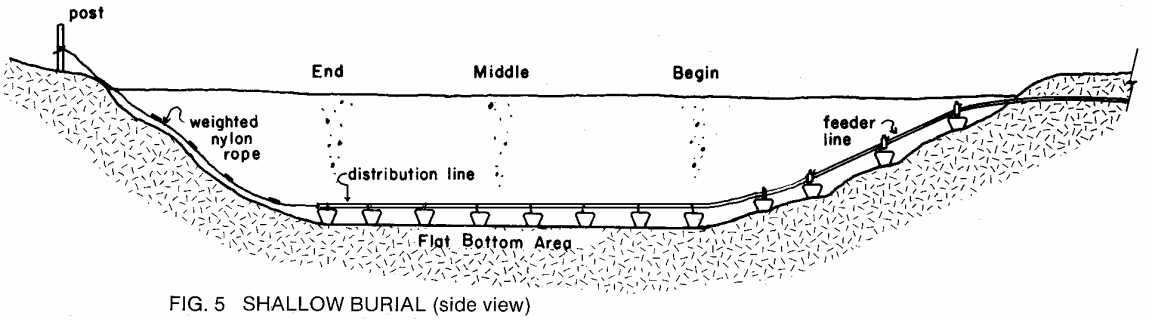


FIG. 5 SHALLOW BURIAL (side view)

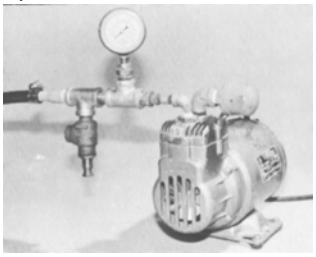
Air Compressor Selection

Two types of compressors are used to power aeration systems: oil lubricated or oil-less.

1. **Oil Lubricated –** Farm–type oil compressors can be used. However, since most are not designed for constant operation, they are not recommended. As well, crankcase oil level requires constant monitoring and noise levels are excessive if installed in occupied premises. Small amounts of oil may spill into the water supply and readjustment of the pressure switch on tank mounted units is necessary to avoid frequent start-ups which reduce motor life.

   When installing oil lubricated compressors, do not directly connect polyethylene pipe, since heat build-up will burst the pipe. A short length of galvanized or copper piping can be used before the plastic pipe to dissipate the heat.

2. **Oil-less-** Piston or diaphragm oil-less compressors are recommended for aeration systems. However, not all diaphragm air compressors are designed for continuous operation. Compressors under 0.25 kw (.33 hp) are normally quiet enough for household operation, but diaphragm units are usually the quietest. They are less costly and easily serviced (replacing diaphragm) in comparison to piston units (replacing rings and valves).
A pressure gauge placed on the discharge side of the compressor is recommended for monitoring the compressor and aeration distribution system operation. Installing a pressure relief valve is recommended to prevent excessive pressure build-up if a malfunction occurs.



Note: Noise levels of larger units may be reduced by connecting the compressor intake to the outside.

Shallow Burial Air Compressor Operation

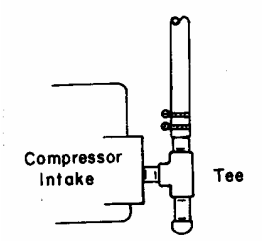


Fig.6 Compressor Suction Connection (side view)

Care should be taken to install compressor units in a dry area. Installation in heated high moisture areas (i.e. laundry room) can result in freezing problems because of the condensation of warm, moist air in the cold feeder line. This can be minimized by connecting the air intake pipe to the outside. Otherwise, the moisture collects and freezes at some point in the feeder line, gradually blocking the pipe. Turn the outside air intake pipe downward to prevent entry of rain or snow. A tee acting as a trap, should be placed at the compressor pump head.

Notes on Aeration System Operation

- To insure the total water in the dugout remains properly aerated; the compressor should be operated continually all year. Research has shown that if the water at the bottom of the dugout becomes septic or is lacking in oxygen, nutrients (food for the algae) will be reabsorbed from the bottom of the dugout resulting in greater alga blooms.

- Installing a permanent aeration system in the above manner is a cheap method of promoting a high quality water source at all times of the year.

Warning: Ice covering aerated dugouts or ponds is not safe in winter. Post signs warning of unsafe conditions and to prohibit snowmobile traffic on the ice.

DESIGN TABLE

Aeration Holes

Size of Dugout (length x width x depth)		Minimum compressor Airflow @ 70 kPa (10 psi)		Length Distribution Line (on flat bottom part of dugout only)		Number of 1.6 mm (1/16in.) holes required in Distribution line Figure 7 (1)			
m	ft.	m^3/hr	cfm	m	ft.	beginning	middle	end	total
50x20x4.3	165x65x14	1.7	1	15	50	2	2	3	7
60x21x4.3	200x70x14	1.7-2.5	1-1.5	15	50	2	2	4	8
90x37x6	300x120x20	5	3	40	130	4	5	7	16
90x60x6	300x200x20	8.5	5	40	130	6	7	11	24

Notes:
1) One 1.6mm (1/16") hole will pass approximately 0.4 m^3/hr (0.25 ft^3/min) of air.
2) 12 mm (1/2 in.) feeder line should not exceed 300 m (1000 ft.)

METRIC CONVERSIONS

Nominal Pipe Diameter

mm	in.
3	1/8
6	¼
10	3/8
12	½
20	¾
25	1
32	1 ¼
40	1 ½
50	2
75	3
100	4
150	6
200	8

Flows
1 Imp. gal. = 4.546 L
1 U.S. gal. = 3.785 L

Dimensions
1 in. = 25.4 mm
= 2.54 cm
1 ft. = 0.3048 m
3.28 ft. = 1 m

Weights
1 oz. = 28.35 g
1 lb. = 0.4536 kg
2.2 lb. = 1 kg

Pressure
1 psi = 6.895 kPa

Power
1 hp. = 0.7457 kW
1 kW = 1.34 hp

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