Filter Tube Dams (De-watering)

DE-WATERING SEDIMENT CONTROL TECHNIQUE

Low Flow Rates	✓	Low Filtration		Sandy Soils	✓
Medium Flow Rates		Medium Filtration	✓	Clayey Soils	[1]
High Flow Rates		High Filtration		Polluted Soils	

[1] Filtration of clay-sized particles may be improved through the incorporation of a grassed filter bed (*Buffer Zone*) down-slope of the filter tube dam.

Symbol

Photo 1 – Filter tube dam

Photo 2 – Note filter tube inlet is raised above ground level to encourage ponding

Key Principles

1. Most filtration systems have only a limited ability to capture and retain clay-sized particles; therefore, operators should not expect a significant change in the colour or clarity of water passing through the filter tubes.
2. Critical design parameters are the 'filtration' capacity of the filter tubes (governed by the pore size and mass per unit area), and the allowable flow rate through the filtration system.
3. The allowable flow rate through the filtration system is governed by the maximum allowable hydraulic head, the length of the tubes, the type of geotextile used in the manufacture of the filter tubes, and the number of parallel filter tubes.
4. Critical operational issues include:
   - the prevention of blockage of the filter tubes by bulk coarse sediment—achieved by either raising the inlet to the filter tubes and/or placing the filter tube dam down-slope of a coarse (Type 3) sediment trap; and
   - controlling sediment 'crusting' that can form on the surface of the filter tubes reducing their discharge—usually achieved by regularly brushing the surface of the filter tubes with a stiff-bristle broom.
5. Gravity-induced 'sedimentation' can be improved by raising the invert of the filter tubes above ground level (minimum 300mm is ideal).

Design Information

One or more parallel filter tubes may be needed depending on the required total flow rate.

The design flow rates for filter tubes can vary significantly depending on the length of the tubes and type of geotextile used in its manufacture. Product-specific pressure–discharge or head–discharge relationships should be obtained from the relevant manufacturer or distributor.

Filter tube dams are most commonly used when the design discharge exceeds the allowable flow rate for a *Filter Fence*, or *Filter Pond*.

Wherever practical, the dams should discharge onto a substantial *Grassed Filter Bed* to assist in the capture of fine sediment particles.

If the manufacturer's head–discharge relationship is not available, then an approximate relationship can be estimated from the specified permittivity of the geotextile. The following procedures (a & b) may be used to estimate a head–discharge relationship.

(a) Filter tubes placed on relatively level ground (as per Figures 1 to 5):

- Allowable flow rate is the lesser of:
  - (i) the assessed flow rate based on the effective hydraulic head (see below);
  - (ii) the hydraulic capacity of the filter tube's inlet (usually governed by orifice or weir flow relationships as appropriate for the site conditions—refer to (b) below).
- Assume fully sediment blockage of the underlying surface area of the filter tube; thus include only the top surface area of the filter tube.
- Assume 10 to 50% blockage of the upper surface area of the bag (depending on intended duration of use and frequency of maintenance).
- When determining the hydraulic head (ΔH), assume zero flow occurs at a water depth of 50mm; therefore, the available hydraulic head is equal to the upstream water level (relative to the under-surface of the filter tubes) minus 50mm.

$$Q = B.F. \times \Delta H \times A \times \psi$$

where:

Q	=	Total flow rate through the filter tube [m^3/s]
B.F.	=	Blockage factor, assume 0.9 to 0.5 depending on expected usage
ΔH	=	Hydraulic head loss through the filter tube [m]
A	=	Upper surface area of the filter tube [m^2]
ψ	=	Permittivity of the geotextile (AS 3706-9) [s^{-1}]

Warning: *It is noted that significant errors can result from the above equation, especially if applied to 'woven' fabrics, thus preference must always be given to head–discharge relationships determined from prototype testing rather than estimations based on standard permittivity testing of the fabric. Note; standard permittivity testing is based on flow rates achieved at a hydraulic head of 100mm.*

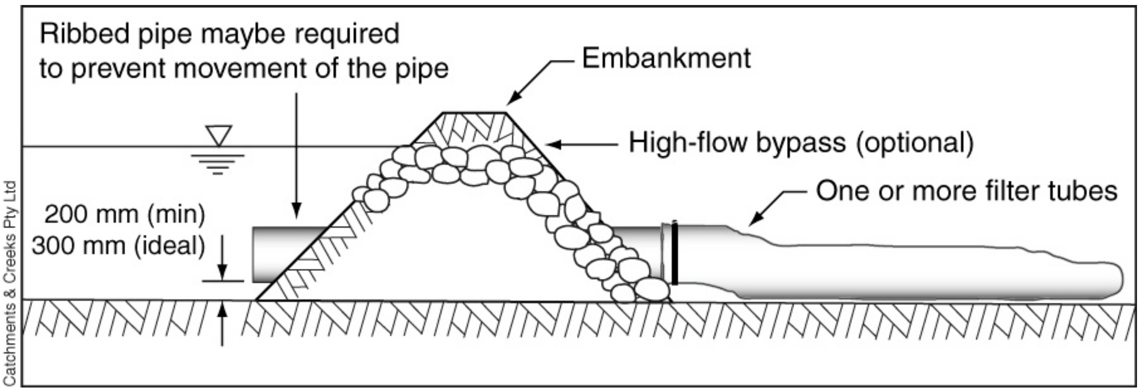

Figure 1 – Typical installation of filter tube dam into an earth dam

(b) Filter tubes placed down a significant slope (say, >5%):

In situations where the filter tube lies down a slope such that the bulk of the filter tube is well below the inlet of the filter tube, the maximum flow rate will usually be governed by the hydraulic capacity of the filter tube's inlet. The hydraulic capacity of the filter tube's inlet is usually governed by orifice or weir flow relationships as appropriate for the site conditions.

The hydraulic capacity of a filter tube's inlet consisting of a solid PVC pipe collar is presented in Table 2. It is noted that the hydraulic head is relative to the invert of the inlet pipe collar.

Table 2 – Hydraulic capacity (L/s) of a round 300 and 375mm diameter pipe inlet [1]

Pipe dia 'D'	Upstream water level 'H' (m) relative to the invert of the pipe inlet												
	0.20	**0.25**	**0.30**	**0.35**	**0.40**	**0.45**	**0.50**	**0.55**	**0.60**	**0.70**	**0.80**	**0.90**	**1.0**
300mm	36	49	62	74	85	96	106	115	123	138	150	160	170
375mm	43	63	82	100	118	134	150	166	180	207	230	250	270

[1] Tabulated flow rates are based on 'inlet control conditions' which assume partial-full, atmospheric flow conditions exist within the filter tube immediately downstream of the inlet.

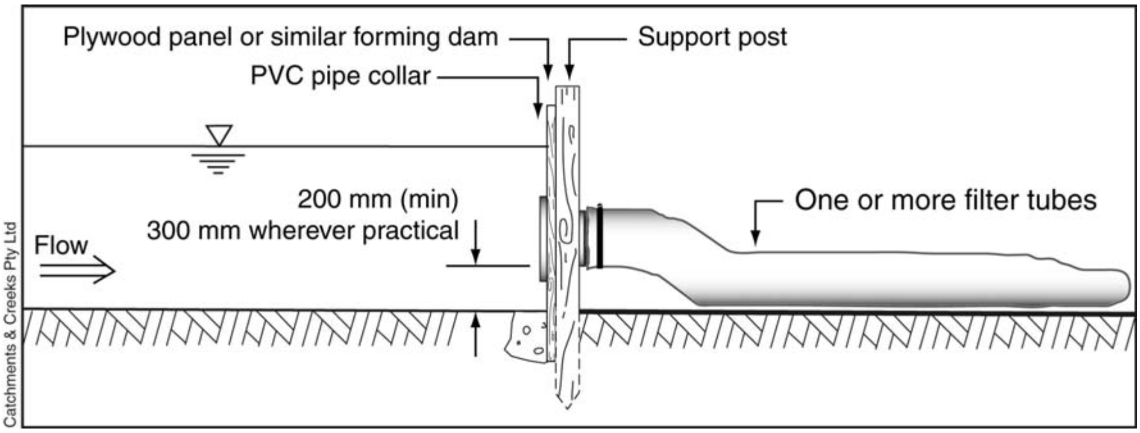

Figure 2 – Alternative formation of a filter tube dam

Filter tubes can be incorporated into distribution tanks to receive and evenly distribute pumped inflow to several filter tubes (Figure 3). Distribution tanks can also be used to balance highly variable inflows and to increase the pressure head.

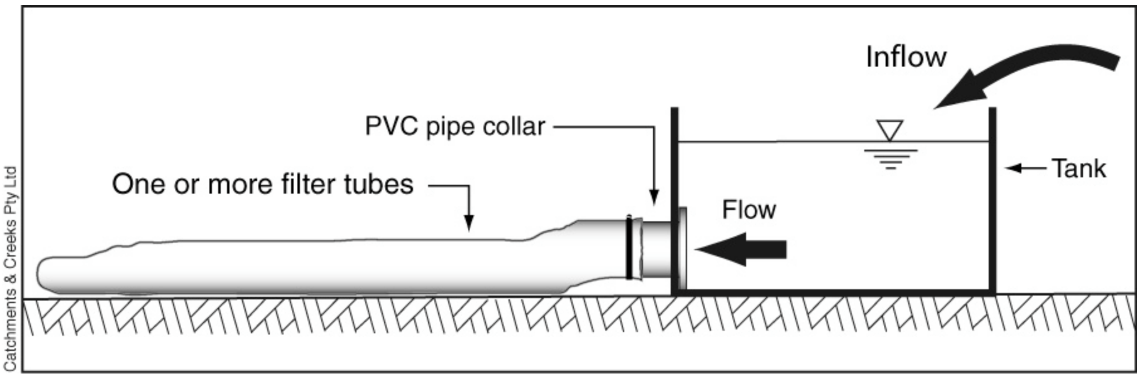

Figure 3 – Filter tube dam incorporated into a distribution tank

Description

One or more parallel long, geotextile tubes incorporated into an impervious dam.

Filter tubes are significantly longer than the more traditional 'Filter Socks'.

Purpose

Used to filter medium to fine-grained sediment particulates from pumped flows.

Limitations

Typically low to medium flow rates.

Limited capture of clay-sized particles.

No treatment of dissolved pollutants.

Advantages

Commercially available product.

Filter tubes are light and easy to handle (when empty).

Disadvantages

Filter tubes can be difficult to handle when full of sediment.

Special Requirements

Consideration **must** be given to how the filters, when full of sediment, can be collected and disposed of.

Where practicable, the filter tube dam should be located up-slope of a *Grassed Filter Bed* to assist in the capture of fine sediments passing through the bag.

Materials

- Filter tube: manufactured from a non-woven geotextile reinforced with a UV-stabilised, woven fabric or poly-propylene mesh. The geotextile fabric should be either polyester or polypropylene. Properties (AS3706) minimum wide strip tensile strength of 20kN/m in both directions; pore size EOS less than 160microns, O_{95} less than 90microns; minimum mass of 300gsm (minimum 'bidim' A44 or equivalent).
- Ribbed pipe (used with earth banks): ribbed, PVC or similar pipe.
- Earth embankment: non-dispersive (Emerson's Aggregate Class 6, 7 or 8) clean earth fill, free of organic debris and with sufficient clay content to prevent the through-flow of water.

Installation

1. Refer to approved plans for location, extent, and details. If there are questions or problems with the location, extent, or method of installation contact the engineer or responsible on-site officer for assistance.
2. Construct a suitable water-retaining dam/tank out of the material specified within the approved plans.
3. While constructing the dam, install and anchor the specified number of ribbed pipe sections through the embankment.
4. Ensure the inlets to each filter tube are set an appropriate height above the adjacent ground level to minimise the risk of sediment blockage.
5. For earth embankment, firmly hand-tamp the earth under and around the ripped pipe/s in lifts not exceeding 100mm. Ensure that all fill material is well-compacted.
6. Suitably connect the filter tubes to the downs-slope end of the protruding connector pipes. Ensure all connections are watertight.

Maintenance

1. Inspect the dam/tank and filter tubes regularly and at least daily during de-watering operations. Make repairs as needed to the fabric.
2. Inspect the filter tubes for obvious leaks resulting from holes, tears or joint failure in the fabric.
3. Repair or replace any filter tube as necessary to maintain the desired operational performance. In some circumstances flow rate through the filter tubes can be temporarily improved by brushing the bag with a stiff-bristle broom.
4. Replace any filter tube if sediment blockage of the fabric decreases the flow rate to an unacceptable level, or the filter tube contains excessive sediment.

Removal

1. Remove of all materials and dispose of them in a suitable manner that will not cause an ongoing erosion or pollution hazard.