



Filtration of microjet/mini-sprinkler trickle irrigation systems

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The successful operation of trickle, mini-sprinkler and microjet irrigation systems depends on minimising blockages through use of proper filtration, line flushing and chlorination.

Outlet size

As a general rule the smaller the outlet or nozzle size the greater the risk of blocking. For this reason mini-sprinklers and microjets are often preferred to the smaller-bore trickle outlets.

Fine filters should be adequate for narrow outlets but minute particles which pass through the finest filters may still cause blockages. On their own such particles move through the smallest outlet, but under some conditions they aggregate into larger particles. When this occurs the finer the outlets the greater the chance of blockage occurring.

This problem has led to recommendations for very fine filtration for trickle irrigation (mesh size 1/8 of the trickle outlet). However, if the water is dirty, fine filters will rapidly clog. A better approach is to use a coarser filter (1/5 of the outlet size) combined with regular chlorination to prevent the aggregation of fine particles.

In cases where filtration is inadequate (for example, due to a break in the filter), microjets and mini-sprinklers may become blocked more readily than finer-bore trickle outlets. Large particles that enter the offtake tube to the microjet or mini-sprinkler are forced into the nozzle, whereas the same size particles usually bypass the smaller trickle outlets.

Avoid dirty filters

Clogged filters will result in system blockages. As the filter clogs, pressure increases on the inlet side. Pliable material, such as algae and water weed breaks up, and is forced through the filter.

Pressure gauges should be installed on both sides (inlet and outlet) of the filter. The filter should be cleaned before the gauges register a large pressure drop across it (greater than 20 kilopascals).

Where filters are cleaned automatically, either by back-flushing (reversing the flow through the filter) or by rinsing the filter element from outside, the cleaning equipment should be adjusted to prevent a large pressure drop across the filter.

Filters can be back-flushed manually but, unless filtered water is used, dirt will be deposited on the inside of the filter element and blockages follow. At least two filters should be mounted in parallel so that the filters can be back-flushed in turn with filtered water. During back-flushing the dirty water should be run to waste.

Size of filter

Most filters are recommended for a wide range of flow rates. However, the higher flow rates result in considerable head loss, increasing both the risk of outlet blockages and the cost of pumping.

Before buying a filter, growers should obtain a pressure loss/flow graph similar to those shown in the figure for a particular brand of 50 mm and 75 mm filters. From these graphs the head loss for a particular flow rate can be calculated.

For instance, if clean water is pumped through the 50 mm filter at 450 litres per minute, the head loss across the filter is 35 kilopascal (kPa), whereas the same quantity of water pumped through the 75 mm filter would result in a 5 kPa head loss. Moreover, if the water is dirty, flow rates of 450 litres per minute will rapidly clog the smaller filter.

Use of a smaller filter will also increase the cost of pumping. As mini-sprinkler, microjets and trickle systems generally operate at around 150-200 kPa at the pump, a head loss of 35 kPa would increase pumping costs by about 20-30%. Clearly the larger filter is required for flow rates of more than 400 litres.

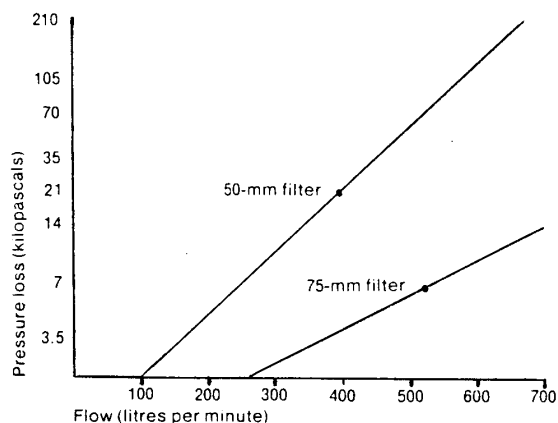


Figure 1. Pressure loss/flow graphs for a particular brand of 50 mm and 75 mm diameter filters

Types of filters

There is now a large and somewhat confusing number of filters suitable for low-flow irrigation. These range from very sophisticated equipment to simple home-made types, which when used within their limits, can be just as effective as the more costly models.

There are three common types: mesh, sand and disc or ring filters. The most common of these is the mesh filter.

Mesh filters

With mesh filters the degree of filtration depends on mesh size. Most types of filter provide the option of a range of mesh sizes. The traditional method of describing the fineness of mesh is by the number of mesh spaces per 25 mm.

The table shows the approximate diameter of the aperture for the various grades of mesh. The table suggests the suitability of such mesh for different sizes and types of outlets, using an aperture size 1/5 of that of the outlet's orifice. This gives a reasonable compromise between overfiltering (with resultant rapid clogging of filters) and the provision of a safe margin for adequate filtration.

As mentioned earlier however, this level of filtration will not exclude very fine material from entering the system, and chlorination will be necessary.

Sand filters

These filters depend on the filtering action of sharp sand or gravel with an aggregate size generally ranging between 1.5 mm and 0.75 mm diameter. This medium is capable of trapping very fine particles (silt, etc.), which would normally pass through other very fine filters. For this reason sand filters are well suited to irrigation systems with fine-bore outlets.

As some large particles move through the sand, mesh filters should be used in conjunction with sand filters, either incorporated in the filter or mounted on the outlet side. Sand filters are always back-flushed and, as explained earlier, at least two filters and preferably three should be mounted in parallel.

When a sand filter is backwashed the whole of the bed must be lifted and disturbed, and this will only be satisfactorily achieved if the rate of flow during backwashing exceeds the filtering rate by about three to one.

To enable the filter bed to consolidate before again becoming an efficient filter the flow for the first minute or two after backwashing should be bled off and not allowed to enter the reticulation system. Alternatively, the back-up mesh filter can be relied on to keep out large particles while the bed is consolidating. Sand filters can be home-made and designs are available.

Table 1. Relationship of mesh size to diameter of aperture and suitable type of outlet

Mesh size (No. of mesh per 25 mm . Approx. 60% air space)	Approx. diameter of mesh aperture mm	Minimum size of suitable nozzle or outlet (5 times diam. of mesh) mm	Type of outlet suited
50	0.3	1.5	Microjets and mini-sprinklers delivering more than 100 litres per hour at 150 kPa pressure.
80	0.2	1.0	Most microjet and mini-sprinkler outlets.
100	0.15	0.75	Most trickle outlets. Microjets and mini-sprinklers delivering less than 30 litres at 150 kPa pressure.
150	0.1	0.5	20-thou. microtube

Disc or ring filters

These generally consist of a series of grooved rings which, when tightened, form a cylindrical filtering body. Different grades of filtering can be achieved by varying the size of the grooves. In this respect the ring filter is similar to a mesh filter but the cylindrical filtering body is three dimensional like the sand filter.

In theory the volume component of both ring and sand filter should provide more efficient filtration than the two-dimensional mesh filters.

The Lewis filter

The Lewis filter could be classified as a mesh filter but is sufficiently different to warrant separate mention.

The filter is suspended by a float in a dam or channel on the suction side of the pump. Jets mounted on a rotating arm continually back-flush the filtering mesh.

The Lewis filter has proved to be extremely useful where the water source is extensively contaminated with algae or water weed which would quickly clog other filters.

Though the filter screen is at least 80 mesh and capable of removing very fine material, the Lewis filter is generally backed up by another filter on the outlet side of the pump.

General recommendations

- The filters should be large enough for the maximum quantity of water pumped, so that there is no more than a 20 kPa pressure drop across a clean filter.
 - Avoid using too fine a mesh size. Chlorinate the water and use a mesh size as suggested in the table.
 - Back-flush with clean water using parallel filters, or clean filters regularly by hand. Fit two pressure gauges across each filter and avoid excessive pressure drop as it clogs.
- Use screens of large mesh size on the inlet side of the pump to remove large debris.
 - Though costly, the best filtration is probably achieved by the use of filters at the pump and also further down the line (that is, filter twice). The combination used could depend on the quality of water to be filtered. For example:
 - where the water is extensively contaminated with algae or water weed use a Lewis filter on the suction side of the pump backed up by a mesh or ring filter on the outlet side.
 - For very muddy water or where fine-bore tricklers are installed, the best choice may be a sand filter on the outlet side of the pump backed up by a mesh filter further down the line.
 - For reasonably clean water use an automatically cleaning filter on the outlet side of the pump backed up by a filter that is cleaned manually.

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