Manual on Irrigation Filters

National Committee on Plasticulture Applications in Horticulture
Department of Agriculture & Cooperation
Ministry of Agriculture, Government of India
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Foreword

The Centrally Sponsored Scheme on Micro Irrigation was implemented in 2006 to provide thrust for achieving higher level productivity through micro irrigation as availability & quality of water is the most critical inputs for agriculture. The Task Force on Micro Irrigation estimated a potential of 69 million ha under micro irrigation. Government of India, MoA has launched National Mission on Micro Irrigation (NMMI) & other central sector schemes such as HMNEH, NHM, RKVY, NFSM etc for enhancing crop productivity, quality and higher economic returns to end users.

Filter is one of the important component in drip & sprinkler irrigation systems. Filtration prevent solids from clogging valves or accumulating in water-distribution piping system. Drip & Sprinkler irrigation system not only save water, power, labour etc but also reduce environmental problems such as water logging, soil salinity affecting crop yields. In the days to come, farmers would look beyond the conventional method of irrigation due to scarce availability of water, shrinkage of cultivable land coupled with food security of the nation.

National Committee on Plasticulture Applications in Horticulture (NCPAH) made an effort to compile relevant information on different type of irrigation filters used in MI system with practical tips on selection, use & maintenance for the practitioners who would play significant role in bringing awareness and develop the skill level of the end users to take advantages of water use efficiency in Drip & Sprinkler irrigation system used in different crops.

It is hoped that the financial assistance under the mission will boost micro irrigation sector in the country.

21st January, 2011

(Gorakh Singh)

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Annexure

Introduction

Filtration is a vital process of any irrigation system. Filtration prevents solids from clogging of valves or accumulating in water-distribution piping system. Irrigation-filtration equipment can be broadly classified in four different types:

1. Screen filters
2. Centrifugal separators / Hydrocyclone Filter
3. Disc filters
4. Sand media filters

Water quality is the determining factor for selecting a filter in irrigation system. Some filters work well on inorganic particulate, such as sand and sediment. Others function better when dealing with organic contaminants such as algae. Knowing the water quality, coupled with basic understanding on the available filter types, makes the filter selection process easier.

What is a filter?

Filters are component made of mild steel, plastic which restricts, examines and prevents flow of obstructions contaminants mixed in the water.

Need for a filter

1. Filters are essential due to small cross section of nozzles, emitters/drippers used in micro irrigation systems, which are susceptible to clogging.
2. Clogging of nozzles, emitters/drippers reduces system efficiency affecting crop yield and increases energy consumption along with maintenance cost of the irrigation system.
3. The selection of filter depends upon the water quality and pressure required by the irrigation system. The details are given in **Table No.1 (a & b)**

Table 1a. Classification of irrigation water

S. No	Type	Specification	Salt availability
1.	Excellent	<175 ppm	Dissolved salts
2.	Good	175 – 525 ppm	Dissolved salts
3.	Permissible	525 – 1400 ppm	Dissolved salts
4.	Unsuitable	< 2100 ppm	Dissolved salts

Table 1b. Classification of irrigation water quality

USDA Classification of Irrigation Water Quality				
S. No.	**Salinity class**	**EC at 25^{0}C**		**Salt concentration**
		Micro mhos/cm	**dS/m**	**mg/l**
1.	Low salinity	0-250	<0.25	<200
2.	Medium salinity	250-750	0.25-0.75	200-500
3.	High salinity	750-2250	0.75-2.25	500-1500
4.	Very high salinity	2250-5000	>2.25	>1500

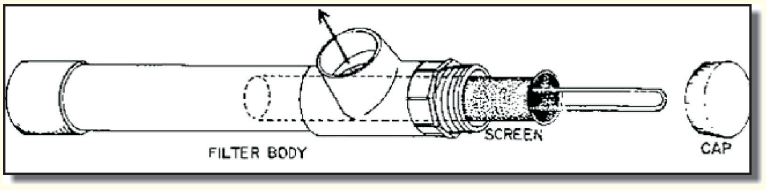
Type of Filters used in Micro Irrigation System

There are different types of filters available for the removal of physical contaminants from irrigation water. Selection of a filter depends on the type and amount of contaminants present in the irrigation water.

Following are the major types of irrigation filter used in the micro irrigation system:

Screen Filters

These are simple and economical filtration devices of various shapes and sizes, most frequently used for the removal of physical contaminants. They can be made of metal, plastic or synthetic cloth enclosed in a special housing. Screen filters are recommended for the removal of very fine sand or large-sized inorganic debris. It is normally not effective to use screen filters for the removal of heavy loads of algae or other organic material. These filters have BIS certification **(IS: 12785:1994)**



When surface water is used for irrigation, screens are often used as secondary filters, after organic matter removed with the help of sand / media filters. It prevents washed out media from entering the irrigation system, however when well water is used for irrigation, a screen filter may

be used as the primary filter or it may be secondary to a hydrocyclone sand separator or hydrocyclone filter, depending upon mineral particle load available in the water.

Screen sizes

Filtering screens are classified according to the number of openings per inch, with a standard wire size given for each screen size as given in **Annexure - 1.**

It is recommended to remove particles, down to a size four times smaller than the emitter's orifice so that grouping and bridging of particles will not cause clogging. The maximum tolerable particle size for a given emitting device should be provided by the manufacturer. When organic particles with a density becomes same as the density of water starts clogging the system. However particles heavier than water, typically mineral particles, may settle and collect in the low flow zones of the irrigation system.

Criteria for selection of Screen Filter

While estimating the appropriate size of filter for a specific application, one needs to consider;

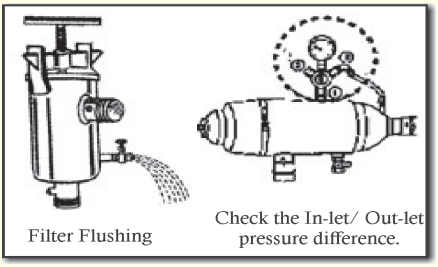
- Water quality
- Volume of water required to pass through the filter between consecutive cleanings
- Filtration area of the filter screen
- Pressure drop through the filter

Screen filters are normally designed to manage wide range of discharge rates. However, rate of discharges that are large in relation to the filtering surfaces will result in higher pressure losses, reduces life of the filter and requires frequent cleaning. The selection of mesh size is in relation to cross-sectional area of the main pipe. The desirable ratio is 2 or more (area of openings much larger than the cross-sectional area of the pipe). The details for mesh size of the filter are given at **Annexure - 1**.

Features of Screen Filters

- Manufactured from reinforced engineering plastic material.
- Available in various sizes from ¾" up to 2".

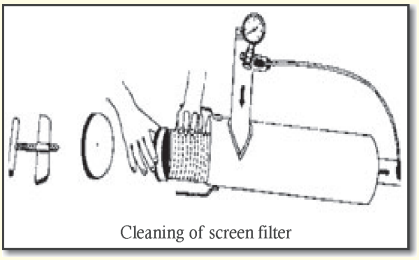
- Maximum operating pressure is 10 kg/cm^2.
- Gross weight is in the range of 0.2 – 3.7 kg.



Maintenance of Screen Filter

Flushing at scheduled interval is necessary to maintain the screen filter. It is recommended to flush screen filter, when pressure drops more than 0.5 kg/cm^2 (5 m at water head). The pressure difference can be observed by checking inlet and outlet pressure with the help of pressure gauges.

Flushing can be done simply by opening the drain valve, allowing the force of water to flush the dirt through drain valve. It is also necessary to clean the screen at regular interval. The procedure for cleaning is very simple. Open the screen filter lid, remove the screen & clean with the help of flowing water by rubbing with cloth or soft nylon brush. Protect the metal parts of the filters from scratches, acid/ chlorine/fertilizer spillage etc. Apply oil paint immediately on the scratch to avoid corrosion.


Cleaning of screen filter

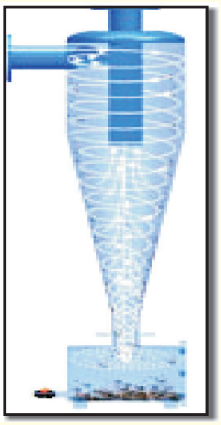
To get maximum efficiency and optimum result, it is necessary to prevent emitter, mini sprinkler and laterals from clogging. Thus filtration system is the heart of irrigation system. Properly maintained filters will ensure maximum efficiency of irrigation system, and prevents clogging.

Centrifugal Filter (Hydrocyclone)

This is also known as "sand separators". Centrifugal filters are primarily used for removing particulates, such as sand present in the water. It is most effective when lot of sand is present in the water and don't allow clogging in the system.

The dirty water when enters the filter where it is swirled around the inner surface of cylinder. The centrifugal force causes the sand particles to move towards the outer edge of the cylinder where gradually slides down to a holding tank placed at the bottom. Centrifugal filters are little expensive

but simple, and are very effective for removing sand from the water. Normally it is used when water is pumped from the well. Generally if the diameter of the well is more than 2.5 inches then centrifugal filter is installed inside the well. These filters typically are attached to the bottom of a submersible pump. It is not unusual to observe small amount of sand passing through the centrifugal filter. In case of drip irrigation system centrifugal filter is used in combination with a sand/ media filter which minimizes clogging in the system. The centrifugal filter removes the sand, while the media filter separates the organic impurities present in the water.



Selection of centrifugal filter must match with the rate of discharge to have optimum system efficiency. Always consult manufacturers' technical guidelines for selecting a centrifugal filtration for irrigation system. These filters have BIS certification **(IS: 14743:1999)**

To get maximum efficiency and optimum result, it is necessary to prevent emitter, mini sprinkler and laterals from clogging. Thus filtration system is the heart of irrigation system. Properly maintained filters will ensure maximum efficiency of irrigation system, by avoiding clogging.

Maintenance of Hydrocyclone Filters

Hydrocyclone filter requires minimum maintenance, if cleaning the dirt, inside the under flow chamber is done at periodic interval. Flush the chamber by opening the flush valve/cap or main valve, for proper cleaning. It is observed that the hydrocyclone filter becomes ineffective once the collection chamber is filled with dirt.

Always ensure to run the hydrocyclone filter at nominal operating pressure of 2 Bar. Excess pressure and uncleaned dirt chamber would cause erosion of filter assembly walls.

Disc Filters

Disc filters are a cross between screen and media filter, having advantages of both. Disc filters are good at removing both sand and organic matter present in the

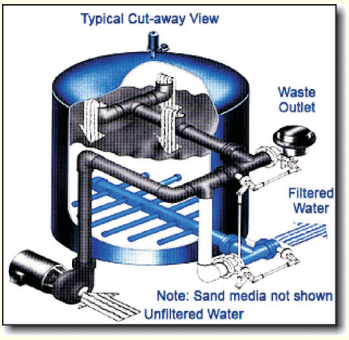
water. A disc filter consists of a stack of round discs. The face of each disc is covered with small bumps of different sizes. A close view of the bumps reveal that each has a sharp point on the top of it.

These bumps are very small, thus a typical disc looks like the old vinyl 45 RPM records. Because of these bumps, when the discs are staked together they create tiny spaces between them. The water is forced between the discs and the particulates are filtered out because they do not fit through these gaps. The organic particles present in the water are snagged by the sharp points on the bumps. For automatic cleaning of the filter discs are separated from each other, which removes debris through the flush outlet.

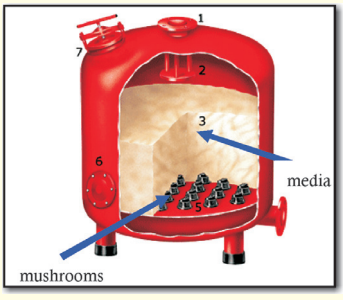
To get maximum efficiency and optimum result it is necessary to prevent emitter, mini sprinkler and laterals from clogging. Thus filtration system is the heart of irrigation systems. Properly maintained filters will ensure maximum efficiency of irrigation systems, by avoiding clogging.

Sand/Media Filters

Media filters clean the water by forcing it through a container filled with a small and sharp edged "media". In most cases the media material used is uniform sized crushed sand. The water passes through the small spaces between the media grains. The debris is stopped when it can't pass through these spaces.



Media filters are used for removing organic material from the water. Filtration media is *crushed silica* sand / quartz gravel of particle size in the range of 0.7 mm to 1.2 mm (0.027 to 0.047 inch). The effective filtration is at 75 micron (200 mesh). The maximum pressure rating is 10 kg/cm². The force of the water going backwards through the filter lifts and separates the media which frees the debris and washes through a flush valve. In the process

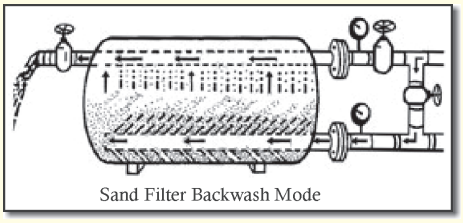


of backwash small amount of media is often also washed out. Therefore, it is necessary to add periodically some more in the filters. For proper functioning media filters need to be carefully matched with the system flow rate for proper and efficient operation. These filters have BIS certification **(IS: 14606:1998)**

To get maximum efficiency and optimum result it is necessary to prevent emitter, mini sprinkler and laterals from clogging. Thus, filtration system is the heart of irrigation system.

Properly maintained filters will ensure maximum efficiency of irrigation systems, by avoiding clogging.

Maintenance of Sand/Media Filters


Sand Filter Backwash Mode

Sand filter is effective for removing heavy organic and inorganic contaminates. Over a period, the contaminants present in the water accumulate and clog pore space in the sand bed and reduces the efficiency of the filter. Daily backwashing of sand filter is very important for proper functioning. Backwashing is a process in which water flow is reversed and sand bed is lifted and expanded for releasing the collected dirt. The dirt is then flushed through backwashing valve.

Backwash flow rate should be adjusted as per the size of the filter. Excessive backwash flow rate will lead to erosion of sand present in the filter and insufficient backwash flow rate will not clean the dirt properly.

Sequence of Backwash Operation (BOBI)

Step 1. Open the **B**ackwash Valve.

Step 2. Close the **O**utlet Valve.

Step 3. Open the **B**ypass Valve.

Step 4. Close the **I**nlet Valve.


Sand Filter Cleaning

***Note*:** In semi-automatic and automatic backwash operation, opening and closing of the valve is done at the same time.

Backwash operation is complete when clear water starts flowing out through the backwash valve.

To Resume the Filtration Process (IBOB)

1. Open the **I**nlet Valve
2. Close the **B**ypass Valve
3. Open the **O**utlet Valve
4. Close the **B**ackwash Valve

The sand filter should also be cleaned regularly as follows:

1) Open the Lid of sand filter
2) Start the Back flush operation
3) Put your hand inside the sand filter and stir the sand thoroughly.
4) Allow all the water alongwith dirt to flow through the main hole of the sand filter.
5) Close the lid for proper operation.

Install the filter on properly constructed masonry or concrete platform. Connect all the assembly properly. Ensure that all the filter candles inside the sand/media filters are at its place before filling up the sand. If hydrocyclone is to be connected to sand filter, install air release valve at the highest point of the fittings.

Trouble Shootings

Acid Treatment

- ☞ To prevent the precipitation and accumulation of dissolved salts in the system.
- ☞ Hydrochloric acid (HCL) having a concentration of 36% is injected into the system till the soil pH value is observed to be 4 at the rear end of the field.
- ☞ The system is then shut off for 24 hrs.
- ☞ Next day the system is flushed by opening the flush valve for 20-30 minutes before resuming operation.

Procedure for Acid Treatment

1. Take 1 lit. of water in a plastic container or jar.
2. Add acid drop by drop in water using a dropper. Stir the water well and measure the pH value of water equal to 4.

3. Measure the quantity of acid in ml required to obtain pH value 4.
4. Calculate the injection rate of the acid by following equation:

Injection rate of acid in lph (Qr) = (3.6 x Qs x A) ÷ V

where, Qs = System flow rate, lps

A = Acid quantity in ml required to achieve a desired pH

V = Volume of test sample of volume 'V'

Chlorine Treatment

- Bleaching powder is used for chlorination in micro irrigation system.
- It is dissolved in water for irrigation and injected into the system for about 30 minutes.
- Bleaching powder is added into the source at a rate of 2 mg/liter.
- System is shut off for 24 hrs. after chlorine treatment.
- After 24 hrs the lateral end and flush valves are opened to flush the entire system.

Safety Precautions during Acid & Chlorine Treatment

- ☞ Protective glass and hand gloves should be used to protect eyes and skin.
- ☞ Never add water to acid. Always add acid to water for dilution.
- ☞ Acid and chlorine treatment should not be carried out simultaneously .
- ☞ If acid comes in contact with any part of the body during the treatment, wash the affected parts and consult a doctor immediately.
- ☞ Do not inhale acid fumes or chlorine gas.
- ☞ Ensure that equipments/accessories used during operation are resistant to acid attack.
- ☞ Backwash the filter before performing acid or chlorine treatment.

Do's & Don'ts

- ☞ Clean the filters after every 5-6 hours or recommended as per the water quality.

- Operate the by pass valve of the header assembly to obtain desired pressure in the system
- Pressure must be 1.5-2 kg/cm^2 at the inlet of the filter
- The pressure difference between the inlet and outlet is more than 0.5 kg/cm^2 suggests cleaning of filters.
- The sand used in the filter is *Crushed Silica Sand* having angular particles due to which it interlocks the dirt particles.
- Never use ordinary sand in the filter.
- Perform acid treatment periodically
- Sand present in the Sand Filter and Screen in case of Screen filter must be inspected and cleaned periodically.
- In case of sand filter, sand levels are marked by the manufacturer. Frequent inspection to be made to ensure the level of sand, if the level is low then refill up to the desired level required for attaining optimum filtration efficiency.

Suggested Filter types based on Water Source

S.No	Water Source	Suggested Filter Types
1.	Municipal Water System	Screen Filter, Hydrocyclone Filter, or Disc Filter.
2.	Well	Screen Filter, Hydrocyclone Filter, or Disc Filter.
3.	River or Creek	Disc Filter, Media Filter and Screen Filter, Hydrocyclone and Media Filter.
4.	Pond or Lake	Disc Filter, Media Filter and Screen Filter, Hydrocyclone and Media Filter.
5.	Spring or Artesian Well	Screen Filter, Centrifugal Filter, or Disc Filter.
6.	Organic Material in Water	Disc Filter, Media Filter and Screen Filter, Hydrocyclone and Media Filter.
7.	Sand in Water	Screen Filter, Hydrocyclone Filter, or Disc Filter.

Representative screen mesh numbers and the corresponding standard opening size equivalents

S.No.	Screen size	Opening size	
	mesh	mm	microns
1.	4	4.76	4760
2.	10	2.00	2000
3.	20	0.711	711
4.	40	0.42	420
5.	80	0.18	180
6.	100	0.152	152
7.	120	0.125	125
8.	150	0.105	105
9.	180	0.089	89
10.	200	0.074	74
11.	270	0.053	53
12	325	0.044	44

The minimum size of particle retained by a screen filter with a certain mesh can be determined as follows:

Soil particle size classification and corresponding screen number

S.No	Soil classification	Particle size			
		mm	microns	inches	Screen mesh number
1.	Very coarse sand	1.00 - 2.00	1000 - 2000	0.0393 - 0.0786	18 - 10
2.	Coarse sand	0.50 - 1.00	500 - 1000	0.0197 - 0.0393	35 - 18
3.	Medium sand	0.25 - 0.50	250 - 500	0.0098 - 0.0197	60 - 35
4.	Fine sand	0.10 - 0.25	100 - 250	0.0039 - 0.0098	160 - 60
5.	Very fine sand	0.05 - 0.10	50 - 100	0.0020 - 0.0039	270 - 160
6.	Silt	0.002 - 0.05	2 -50	0.00008 - 0.0020	—*
7.	Clay	0.002	2	0.00008	—*

* *Screens are not normally used to remove particles of these sizes.*

Water analysis as per BIS 14791:2000

S.No.	Parameters	Degree of presence/problem			
		Unit	Normal	Higher	Extreme
1.	pH		7	<7 Acidic	>7 Alkaline
2.	Electrical Conductivity (Salinity)	mmhos/cm	<0.8	0.8-3.0	<3.0
3.	Total dissolved solids	ppm	<500	500-600	>600
4.	Hardness	ppm	<200	200-300	>300
5.	Calcium	ppm	<60	60-100	>100
6.	Magnesium	ppm	<25	25-40	>40
7.	Carbonate	ppm	<200	200-600	>600
8.	Bicarbonate	ppm	<200	200-600	>600
9.	Chloride (Toxic)	ppm	<140	140-350	>350
10.	Sulphates	ppm	<20	20-50	>50
11.	Sodium	ppm	<100	100-200	>200
12.	SAR	-	<3	3-9	>9
13.	Potassium	ppm	<10	20-50	>20
14.	Sulphides	ppm	<15	15-25	>25
15.	Iron	ppm	<0.1	0.1-0.4	>0.4
16.	Manganese	ppm	<0.2	0.2-0.4	>0.4
17.	Suspended solids	ppm	<10	10-100	>100

**ppm = parts per million*

Glossary of Terms

Bar	A unit of pressure. 1 bar is approximately equal to 10m head or 14.5058 p.s.i (pounds per square inch). 1 bar is also approximately equal to 1 atmosphere.
Centrifugal	Rotational effects and gravity are used to separate mixtures of solids and fluids.
Clogging	Preventing movement.
Emitter	Outlet through which water is designed to flow. Also known as a nozzle, sprinkler or dripper.
Hydrocyclone	Cone-shaped device for separating mixed liquids
Injection	to push or pump.
Mesh	Number of openings in a square inch of screen or sieve.
Media	Material in a filter that traps debris.
Micron	One thousand of a millimeter ($1/1000^{th}$).
Micromhos	A measure of conductance equal to one millionth of a mho.
Mho	Unit of conductivity.
Nozzle	Another phrase for an emitter.
Orifice	An aperture or opening.
ppm	usually used instead of percent (1mg/1 = ppm) known as parts per million.
pH	measure of the acidity or alkalinity of a solution.