Principles of Filtration
Filtration in Irrigation

• Role of filtration in an irrigation system
  • Filters remove *suspended particles* that clog emission devices and hardware
    • Drip emitters, jets, misters/foggers, micro-sprinklers,
    • Valves, air vents, injection quills

• Filters in Irrigation are Mechanical Filters
  • Remove *suspended particles* in the water such as sand, algae, and organic matter
  • CANNOT remove *dissolved solids* in the water, such as salts, iron, and manganese
Water Quality in Filtration

• Total Suspended Solids (TSS)
  • TSS are solids that remain intact when added to water.*
    • Sand
    • Silt
    • Clay
    • Gravel
    • Algae & Bacteria

• If a 1.5 micron filter stops a particle, it is considered suspended

• **TDS**

  • *Total Dissolved Solids (TDS)* only appear as solid material when the sample is dried.
  
  • They are related to conductivity, salinity, alkalinity and measure the hardness
  
  • Particulate amount measured in mass/volume (mg/l) or mass/mass basis (ppm)
    
    • 1000g/l = density of H₂O  =>  1,000,000 mg per liter (PPM)
Water Quality in Filtration

- Particle Size Distribution (PSD)
  PSD testing enables you to evaluate the expected quantity and size of organic and inorganic solids in the water that could potentially clog emitters.
## Filtration Grade

<table>
<thead>
<tr>
<th>Micron</th>
<th>Mesh</th>
</tr>
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<tbody>
<tr>
<td>Actual size of pores in filtration medium in mm or micron. ([1 \text{ micron (} \mu \text{)} = 1/1000 \text{ mm}])</td>
<td>Number of strands or wires per linear inch of screen.</td>
</tr>
</tbody>
</table>

[Diagram of Micron Measurement]

[Diagram of Mesh Measurement]
<table>
<thead>
<tr>
<th>Inches</th>
<th>Mesh</th>
<th>Micron</th>
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<td>0.0007</td>
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<td>0.0787</td>
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* Common screen sizes used for drip irrigation systems
*Filtration requirement for Aqua-Traxx Azul
Determining Filtration Grade

- Protecting Nozzles:
  - What is the diameter of the nozzle?
  - Divide by 3
  - Look at mesh / micron chart to determine the required filtration grade
  - Example: 0.04 inch nozzle
    - Divide by 3 = 0.0133
    - Look at Mesh / Micron Chart

- Protecting Drippers:
  - What is the critical dimension in the dripper?
  - Divide by 7
  - Look at mesh / micron chart to determine the required filtration grade
  - Example: Companies don’t publish the dimensions of their drippers

- Follow the guidelines of the manufacturer of the emission device
Water Quality, Flow Rates, & Mesh

- Dirtier Water Need More Filter Area
- Higher Flow Rates Need More Filter Area
- Finer Mesh Rating More or Less Filter Area?
- Most Automatic Filters require minimum of 30-35 for proper flushing
<table>
<thead>
<tr>
<th>Model Description</th>
<th>Filter Area</th>
<th>Water Quality</th>
<th>80 Micron</th>
<th>100 Micron</th>
<th>130 Micron</th>
<th>200 Micron</th>
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<tbody>
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<td>4&quot; Parallel Short Model AF804NL - Flanged</td>
<td>896 in²</td>
<td>Good</td>
<td>200</td>
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<tr>
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<td>2700</td>
<td>3300</td>
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<td>1200</td>
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<tr>
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<td>640</td>
<td>800</td>
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</table>
Maximum Recommended Flow Rates [gpm]

6" Parallel Long Model AF806NX - Flanged

Filter Area = 1300 in²

<table>
<thead>
<tr>
<th>Water Quality</th>
<th>80 Micron</th>
<th>100 Micron</th>
<th>130 Micron</th>
<th>200 Micron</th>
</tr>
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<tbody>
<tr>
<td>Good</td>
<td>550</td>
<td>575</td>
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<td>Average</td>
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<td>625</td>
<td>650</td>
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<tr>
<td>Poor</td>
<td>480</td>
<td>500</td>
<td>600</td>
<td>625</td>
</tr>
<tr>
<td>Very Poor</td>
<td>380</td>
<td>400</td>
<td>450</td>
<td>550</td>
</tr>
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</table>

Approximately 30% reduction in capacity
## Comparing Levels of Technology

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<thead>
<tr>
<th></th>
<th>Manual</th>
<th>Semi-Automatic</th>
<th>Fully Automatic</th>
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</thead>
<tbody>
<tr>
<td><strong>Water Quality</strong></td>
<td>Good</td>
<td>Good - Average</td>
<td>Average - Poor</td>
</tr>
<tr>
<td><strong>Solution</strong></td>
<td>Good</td>
<td>Better</td>
<td>Best</td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td>Low</td>
<td>Medium</td>
<td>Higher</td>
</tr>
</tbody>
</table>
Typical Drip Irrigation System

1. Surface Reservoir and Pump
2. Chemical Injection Tanks and Equipment
3. Central Valves and Backup Filters

Well Pump

AQUA-TRAXX and FLOWCONTROL Drip Tape – Slow or Non-Fast Drip Irrigation

BLUE STRIPE Oval Hose – Row Crops
BLUE STRIPE Hose & Emitters – Permanent Crops
BLUETRAXX Dripline – Permanent Crops

Greenhouse and Hydroponics

Toro Ag 900 Series Valve
Filtration Methods

Sand Media

• Most Comprehensive Filtration
• Well suited for most water sources, even very poor water quality
• Multi-dimensional filtration; most filtration area
• Simple and reliable
• Small amount of moving parts
• Large Footprint, typically requires assembly on site
• Uses large amounts of flush water (flushes for 90 seconds per tank)
Operation of Automatic Media Filter - Video
Screen Filters

- Versatile Filtration
- Requires frequent flushing in poor water quality
- Short flush cycle (10 seconds)*
- Small Footprint and easy installation
- Uses less volume of flush water
- More moving parts than Sand Media Filters*

*Automatic Screen Filters
Filtration Methods

Disc Filters
- Effective on surface water with algae and organic debris
- Very sensitive to sand and silt – Will clog quickly
- Small Footprint and easy to install
- Less flush water than sand media, but more flush water than Automatic Screen Filters
- High number of moving parts

Hydrocyclone
- Not considered a filter, because it does not have a filter element
- Causes a constant pressure loss of 5-12 psi
Pre-Pump Strainer

- First opportunity for filtration
- Limited to surface water applications
- Typically connected to foot valve
- Coarse filtrations – 16 or 18 mesh [1200 or 2500 micron]
- Requires pressurized water supply for self-cleaning models.
- Prevents large debris from entering pump and system
Hydrocyclones

- The Hydrocyclone is a mechanical separator of solids particles from liquids.
- Centrifugal force is used for the separation process.
- High spinning velocity moves the particles to the walls of the hydrocyclone.
- The Collection Chamber collects and stores the separated material
Design and Shape of the Hydrocyclone Body

- Velocity of the water will naturally slow down, due to friction of the water spinning against the wall of the hydrocyclone.

- Cone shape maintains high velocity as the water spins down across the body, achieving a higher percentage of separation.

- The greater the velocity, the better the separation.
Two (2) Reasons to manifold multiple units together:

- **Varied Flow Rates:**
  - If the water source has varied flow rates, 2 or more cyclones enable the grower to keep the optimal flow rate per unit by shutting 1 tank off using isolation butterfly valves.

- **Separating Silt:**
  - Silt has a very low specific gravity and is more difficult to separate - Greater velocity is required.
  - Multiple small model Hydrocyclones, manifòlded together, can achieve the higher velocity required to separate the silt.
Hydrocyclone with Auto Flush

• When to use auto flush
  • Greater than 5 ppm of sand
  • Ensures flushing the sand out of the tank before it gets 1/3 full

• Flush by time, not pressure differential:
  • Flush for 10 seconds every hour
Manual F100 Series Steel Screen Filters

Application
- Secondary Filtration - Block filter in the field
- Primary filtration for *Good Water Quality*
- Angle configuration fits row crop fields, can lay on a pallet

Features
- Carbon Steel Epoxy Coated Body
- Stainless Steel Screen supported by a PVC cylinder
- Available Sizes:  3”, 4”, 6”, 8”, 10”
- Includes drain valve to release pressure before opening filter
- Easy to disassemble and clean
Manual F200 Series Screen Filters

Application
• Primary or Secondary Filter
• For Good Water Quality
• In Line design is common for primary filtration

Features
• Carbon Steel Epoxy Coated Body
• Stainless Steel Screen supported by a PVC cylinder
• Available Sizes: 3”\text{,} 4”\text{,} 6”\text{,} 8”\text{,} 10”
• Includes drain valve to release pressure before opening filter
• Easy to disassemble and clean
Application:
• Well Water with light to moderate amounts of sand
• Reduces the frequency of manually cleaning the screen

Operation:
• Flow is directed through a circular spin plate with holes
• Causing a spinning motion that pushes heavy particles to the lower section of the filter
• Keeping most of the screen from clogging quickly
• The debris is flushed one of 3 ways
6” F400 Circulating Screen Filter Model

- More Open Holes for higher flow rates
- Less Open Holes for lower flow rates
- Always maintain a 3-5 psi pressure differential when the screen is in a clean state
Ancillary Control Hardware

Common Components
1. Isolation Valves
   • Gate or Butterfly
2. Pressure Relief valve
3. Air & Vacuum Relief valves
4. Chem Check valves
5. Pressure gauges

Optional Components
6. PSNO Valves
7. P. Reg or P. Sust. Valves
8. Flowmeter
9. Injection quill or port
10. Utility poly bolted valves
   • Wafer Check valves
   • “Banjo” valve
Key Takeaways

- Know the water quality of the water source
  - TSS
  - TDS
  - PSD

- Filtration requirement for your emission device

- Available flow and pressure

- Local dealer’s preferred method – service and support are critical.
New Sand Media Filtration System

• Fully integrated filtration system (patent pending) – four tanks in one filter body
• Simplified setup with pre-installed valves & connections, fewer components
• Reduced total installation time – hours instead of days to commission
• Reduced materials & labor for site prep
• Permanent, semi-permanent, or mobile applications