



IDEA 2021

Powering the Future: District Energy/CHP/Microgrids
Sept. 27-29 | Austin Convention Center | Austin, Texas





NEW APPROACHES TO SOLIDS REMOVAL AND FILTRATION

—
A MODULAR
APPROACH FOR
VARIABLE FLOW RATES

Jim Phene – President
Epiphene

ISSUES LIES IN THREE MAIN AREAS

Separator Tech

- Doesn't provide 5-microns Removal
- Doesn't Scale – High Flow & High Efficiency Removal
- Won't handle wide range of flows
- High Pressure Losses

Media Filter Tech

- Single Tank – Poor Design
- High Water Loss
- No Filtration During Backflush
- Won't handle wide range of flows

Design Limitations

- Either/Or
- Full Stream Impractical
- No Surge Capability
 - To Save Energy
 - To Address High Loading Events

COMPARISON – SEPARATORS

Separators most effective in removing inorganic particles & solids with specific gravities greater than 1.2

Current Separator Offerings

- Working Pressure Range 12 to 22 PSI to get any separation.
- Typical removal efficiency only removes 74 microns and some down to 40 Microns
- Jar Test - 3 Minutes shows the typical solids removed.
- Minimum Inlet Pressure – 20 PSI

Epiphene CPH Separators

- Working Pressure Range 1 to 15 PSI for efficient separation
- Typical removal efficiency down to 5 microns and some down to .5 Microns
- Jar Test – 24 hour or 1440 Minutes shows the typical solids removed.
- Minimum Inlet Pressure – 10 PSI

NEW APPROACH TO SEPARATION

ONLY SOLUTION TO REMOVE CLAY, SILT AND SAND

Designed to handle removal of settable solids in cooling systems, irrigation and industrial process as either pre-filter or primary filter.

Incorporates a highly efficient closely packed set of 16 hydro cyclones to reliably remove solids down to 1/2 microns.

Higher flow rates with high efficiency now possible.

Pre-filtration extends time between servicing as much as 5 times for standard bag, cartridge or media filter.

Closely Packed Hydro Cyclone – CPH-16



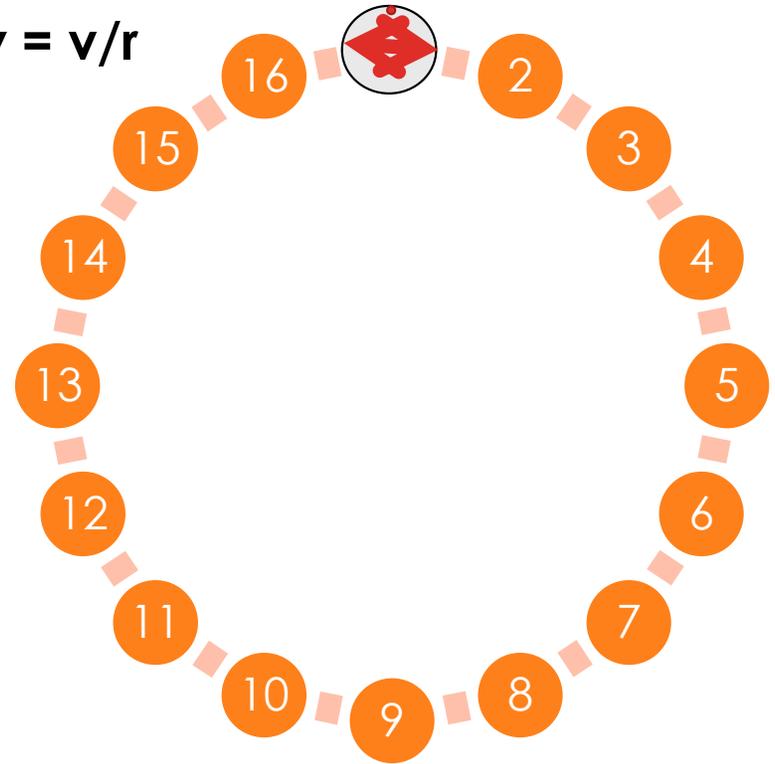
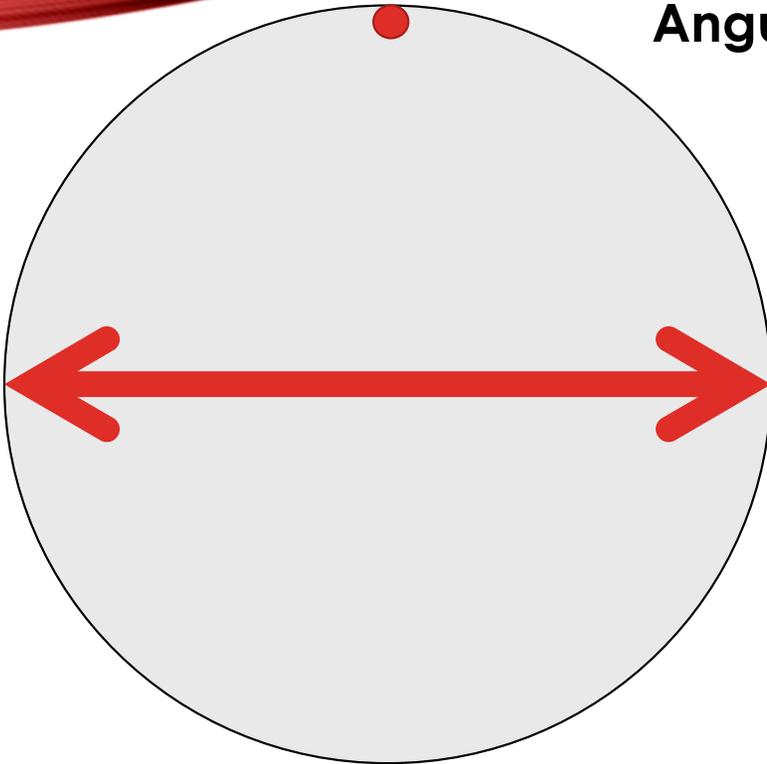
FLOW RATES:
13 TO 132 GPM
50 TO 500 LPM

ACCOMMODATES
HIGHER FLOW
RATES WITH
PARALLEL
DESIGNS

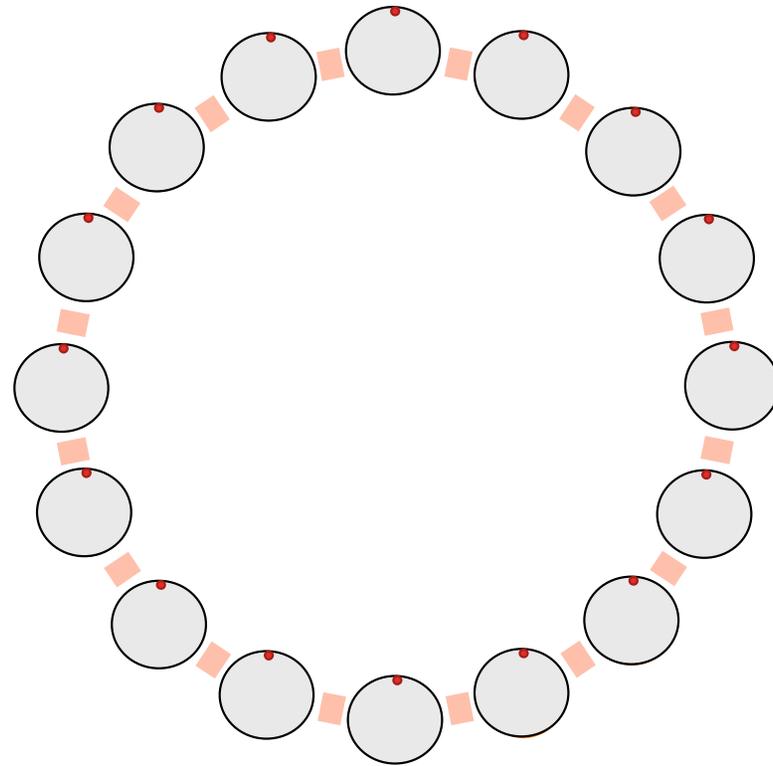
SIXTEEN ONE-INCH HYDRO CYCLONES IN ONE VESSEL
OFFERING 94% REMOVAL OF 15-MICRON SOLIDS &
ABOVE AT 2.6 SPECIFIC GRAVITY.

WHY IT WORKS IT SO WELL

$$\text{Angular Velocity} = v/r$$



WHY IT WORKS IT SO WELL



CPH 16 SEPARATOR PERFORMANCE



THE RELATIVE SIZE OF PARTICLES

From the COVID-19 pandemic to the U.S. West Coast wildfires, some of the biggest threats now are also the most microscopic.

A particle needs to be 10 microns (μm) or less before it can be inhaled into your respiratory tract. But just how small are these specks?

Here's a look at the relative sizes of some familiar particles \blacktriangleright

Cooling System Requirements

HUMAN HAIR 50-180 μm \blacktriangleright
FOR SCALE

FINE BEACH SAND 90 μm \blacktriangleright

GRAIN OF SALT 60 μm \blacktriangleright

WHITE BLOOD CELL 25 μm \blacktriangleright

GRAIN OF POLLEN 15 μm \blacktriangleright

DUST PARTICLE (PM₁₀) <10 μm \blacktriangleright

RED BLOOD CELL 7-8 μm \blacktriangleright

RESPIRATORY DROPLETS 5-10 μm \blacktriangleright

DUST PARTICLE (PM_{2.5}) 2.5 μm \blacktriangleright

BACTERIUM 1-5 μm \blacktriangleright

WILDFIRE SMOKE 0.4-0.7 μm \blacktriangleright

CORONAVIRUS 0.1-0.5 μm \blacktriangleright

T4 BACTERIOPHAGE 0.225 μm \blacktriangleright

ZIKA VIRUS 0.045 μm \blacktriangleright

CPH-16

Wildfire smoke can persist in the air for several days, and even months.

Pollen can trigger allergic reactions and hay fever—which 1 in 5 Americans experience every year.
Source: Harvard Health

The visibility limits for what the naked eye can see hovers around 10-40 μm .

Respiratory droplets have the potential to carry smaller particles within them, such as dust or coronavirus.

Current Separators

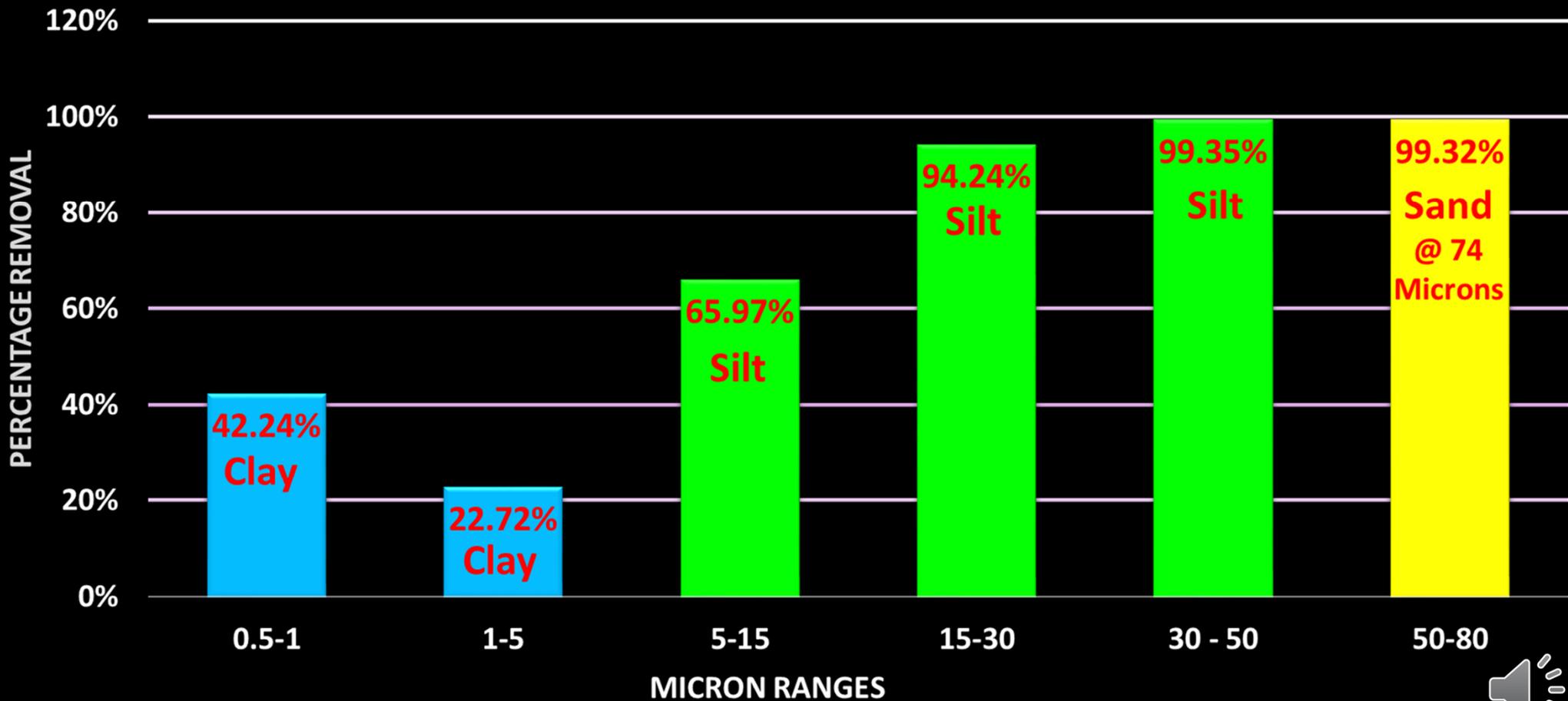
SOURCES Clearstream, Daniel Loverbey, EPA, Financial Times, News Medical, Science Direct, SCMP, Susan Sokolowski, Petroclear, U.S. Dept. of Energy
COLLABORATORS RESEARCH + WRITING Carmen Ang, Iman Ghosh | DESIGN + ART DIRECTION Harrison Schell

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HIGH SOLIDS REMOVAL EFFICIENCY

Sand Separator Test Sand Removal %



JAR TEST COMPARISON

Agitated Sample – The issue to address!

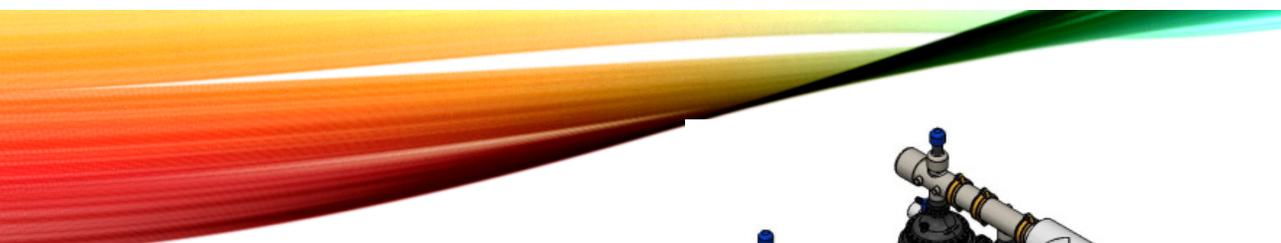


Current Separators limited Removal -Settling after 3 Minutes

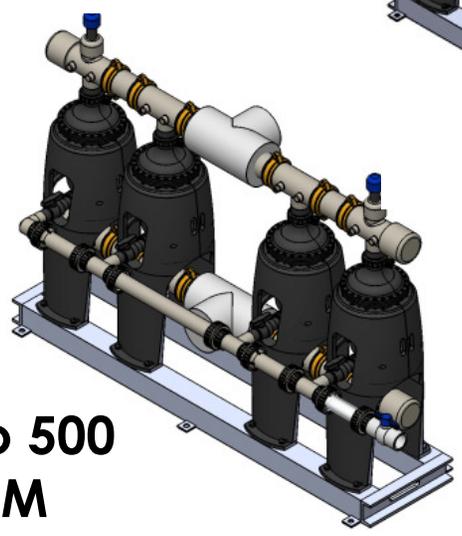
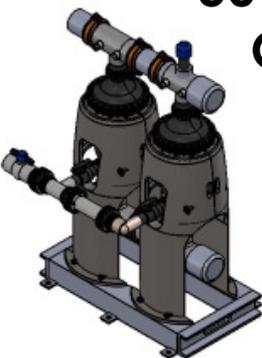


What CPH-16 Removes- Settling after 24 Hours

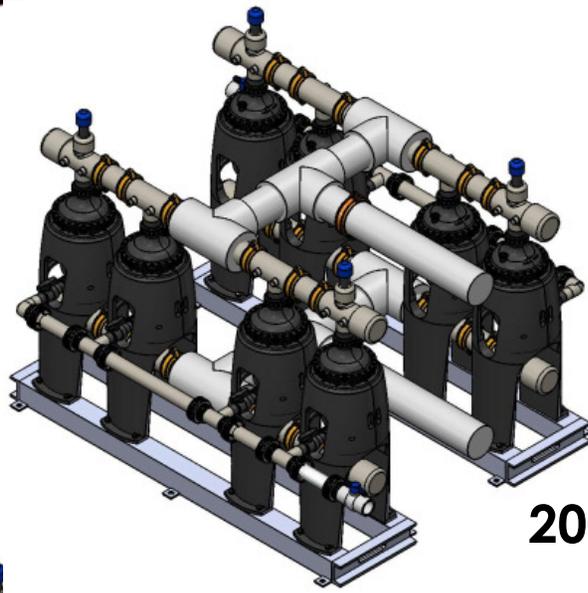




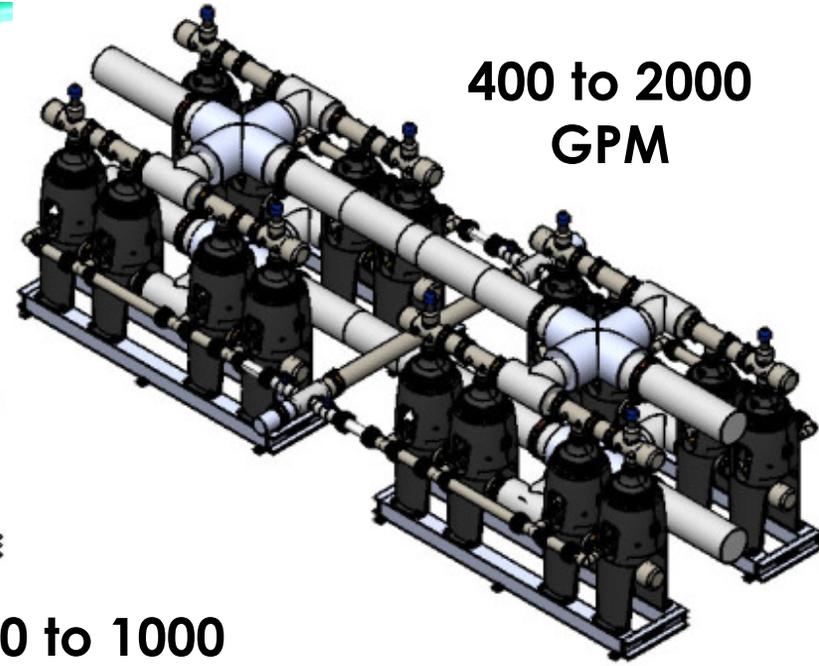
50 to 250
GPM



100 to 500
GPM



200 to 1000
GPM

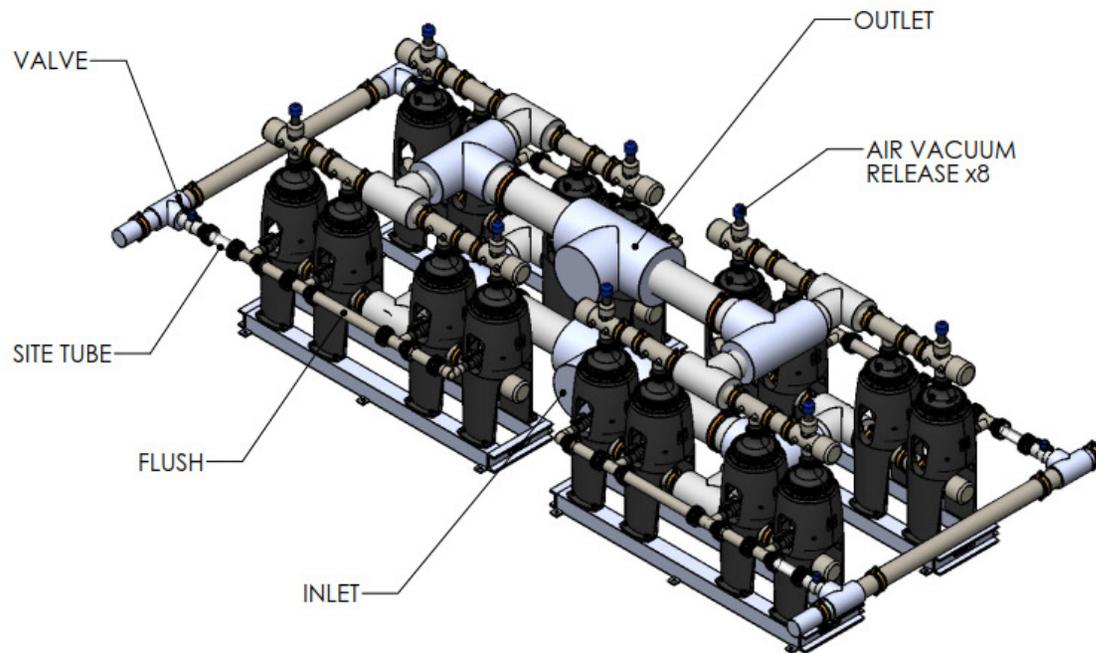


400 to 2000
GPM

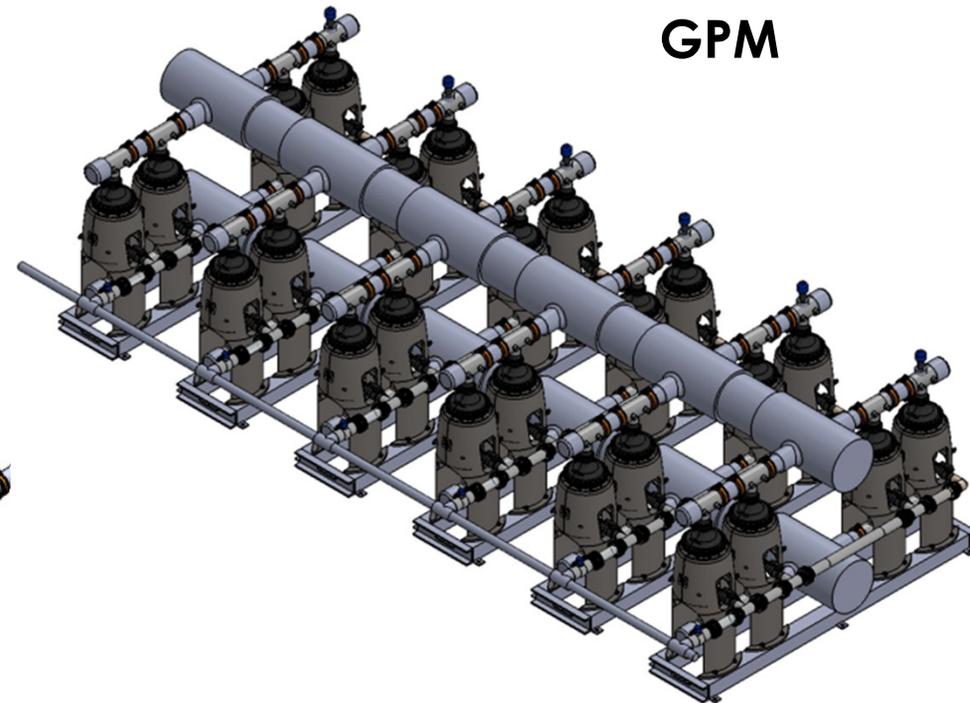
SEPARATOR MODULARITY

SEPARATOR MODULARITY

400 to 2000
GPM

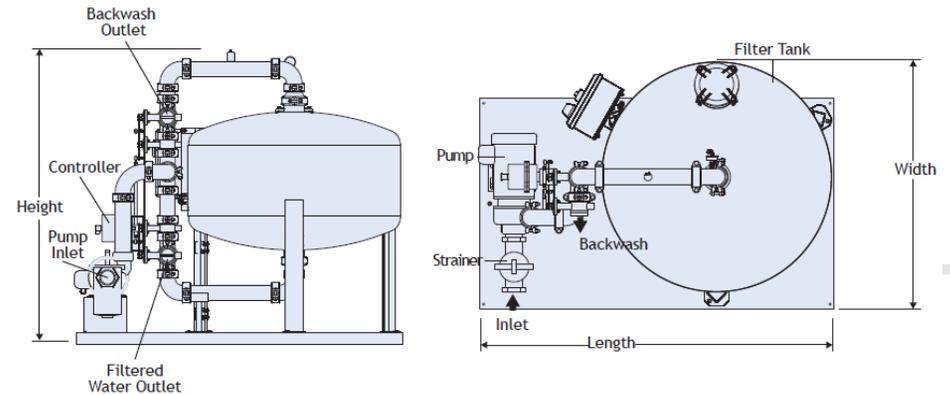


600 to 3000
GPM



CURRENT APPROACH TO MEDIA FILTRATION IN HVAC IS WRONG

- Originally envisioned using clean water source to flush a single filter.
- Someone along the way decided to use the very water being filtered to flush the filter...
- Instead of adding an additional tank as all other industries do to provide filtered water to flush the filter.



- Using Single Tank Solutions leads to
 - No Filtration During Flushing
 - Infiltration of Media by Contaminates
 - High Frequency of Continuous Flushing.
 - Failure of the filtration system

COMPARISON – MEDIA FILTERS

Media Filtration for the most part is most effective for organic particles and solids with specific gravities significantly less than 2.6.

Current Offerings

- **Use Silica Oxides – susceptible to surface sealing from Carbonates and Bicarbonates – leads to high frequency flushing.**
- **Often requires gravel for underdrain support & diffusion – not single media**
- **Design Flow Rates too high for 5 & 10-microns filtration**
- **Underdrain designs have dead areas – contributes to surface sealing**

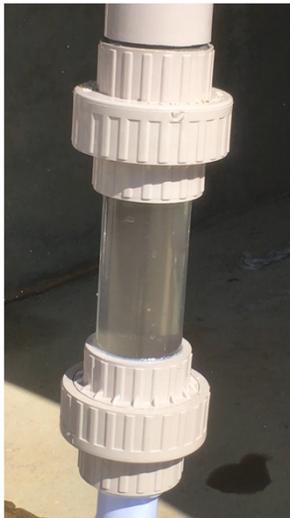
Epiphene Stacked Media

- **Offer Glass Media's – resistant to surface sealing**
- **Offer Single Media Solutions - Underdrain Self-Supporting**
- **Designs offered at flow rates commensurate with 5 & 10-Microns Flux (flow per unit area)**
- **Low-profile underdrain also acts as distribution – covers almost 100% of area under media – no dead areas**
- **Additional advantage – 70% less Media Required**

SMALL STACKED VERSUS SINGLE LARGE TANKS

- **Stackable Solution conserves space and costs for Filter Pad – Up easily 50%**
- **Lower Back Flush Flow reduces impact on Cooling System**
- **Lower Back Flush Flow Rates**
 - **(12 to 50 GPM vs 100 to 1000 GPM)**
 - **Saves Significant Water**
 - **Improves Overall System Efficiencies**
 - **Effectively filters even under high or continuous flush conditions**
- **Lower Back Flush Flow & Pressure Requirements positively impacts**
 - **Design**
 - **Pump & Motor Choices**
 - **Operating Costs**
 - **Life Cycle Costs**
 - **Productivity**

MEDIA FILTER BACKFLUSH (1 OF 8 TANKS – 60 SECONDS)



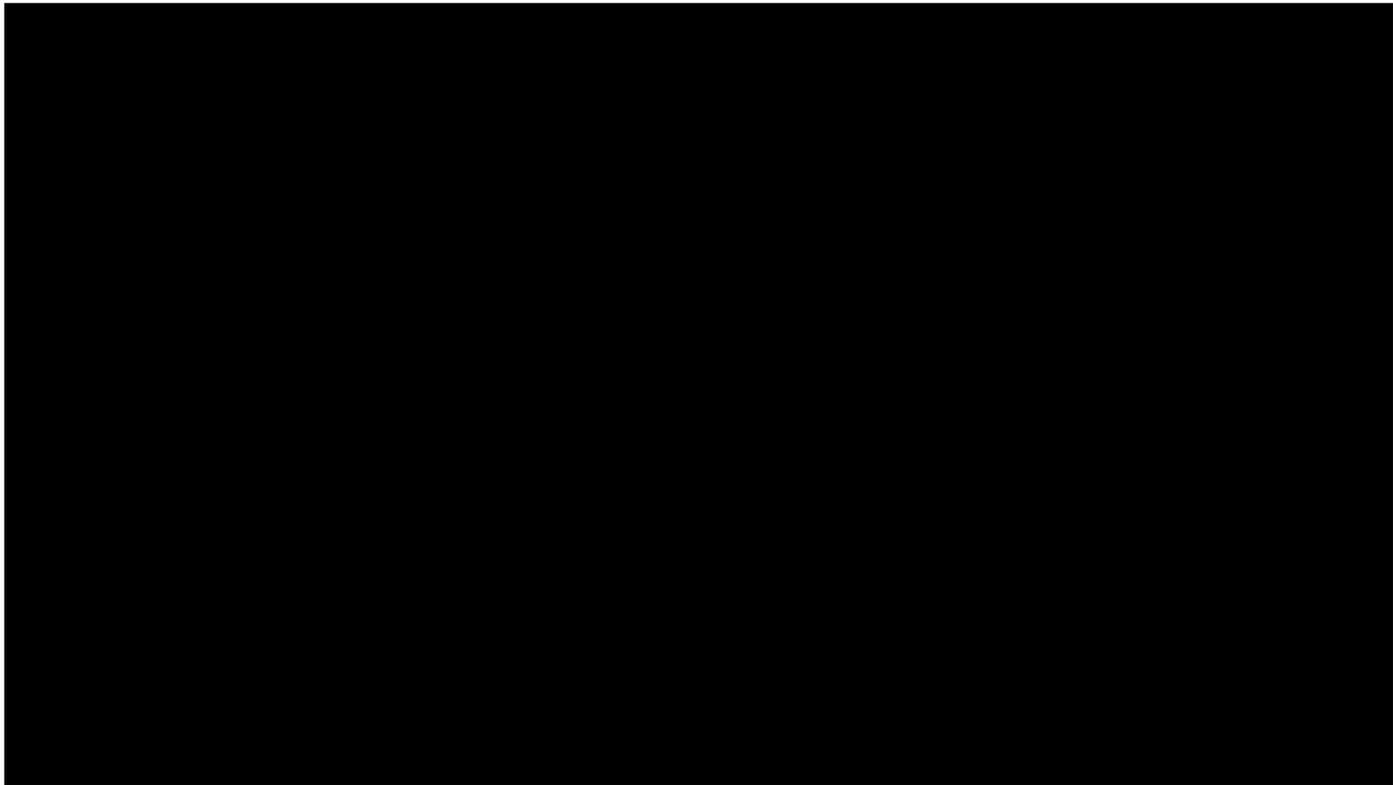
UNDERDRAIN WITHOUT MEDIA



epihene

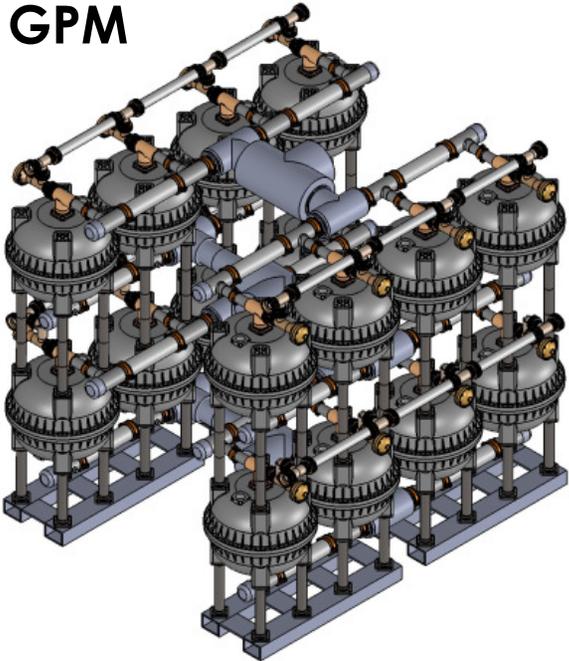


BACKFLUSH WITH MEDIA

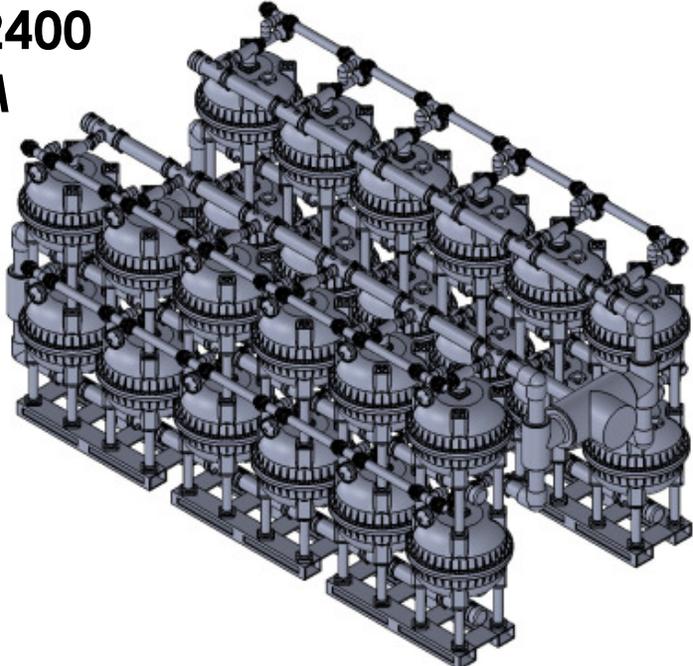


SEPARATOR MODULARITY

250 to 1600
GPM



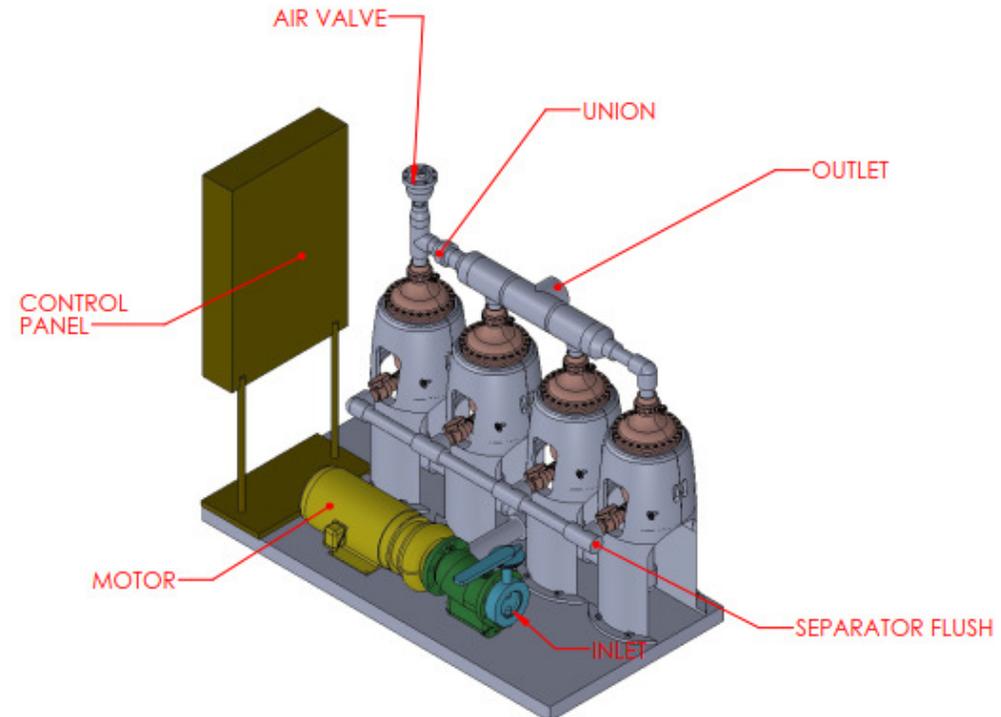
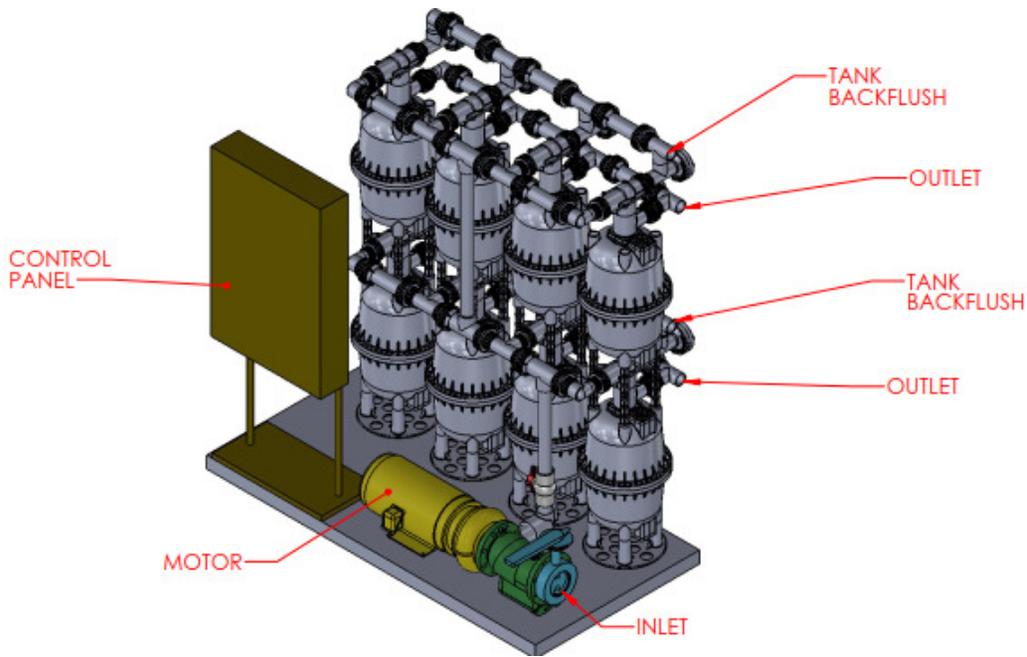
377 to 2400
GPM



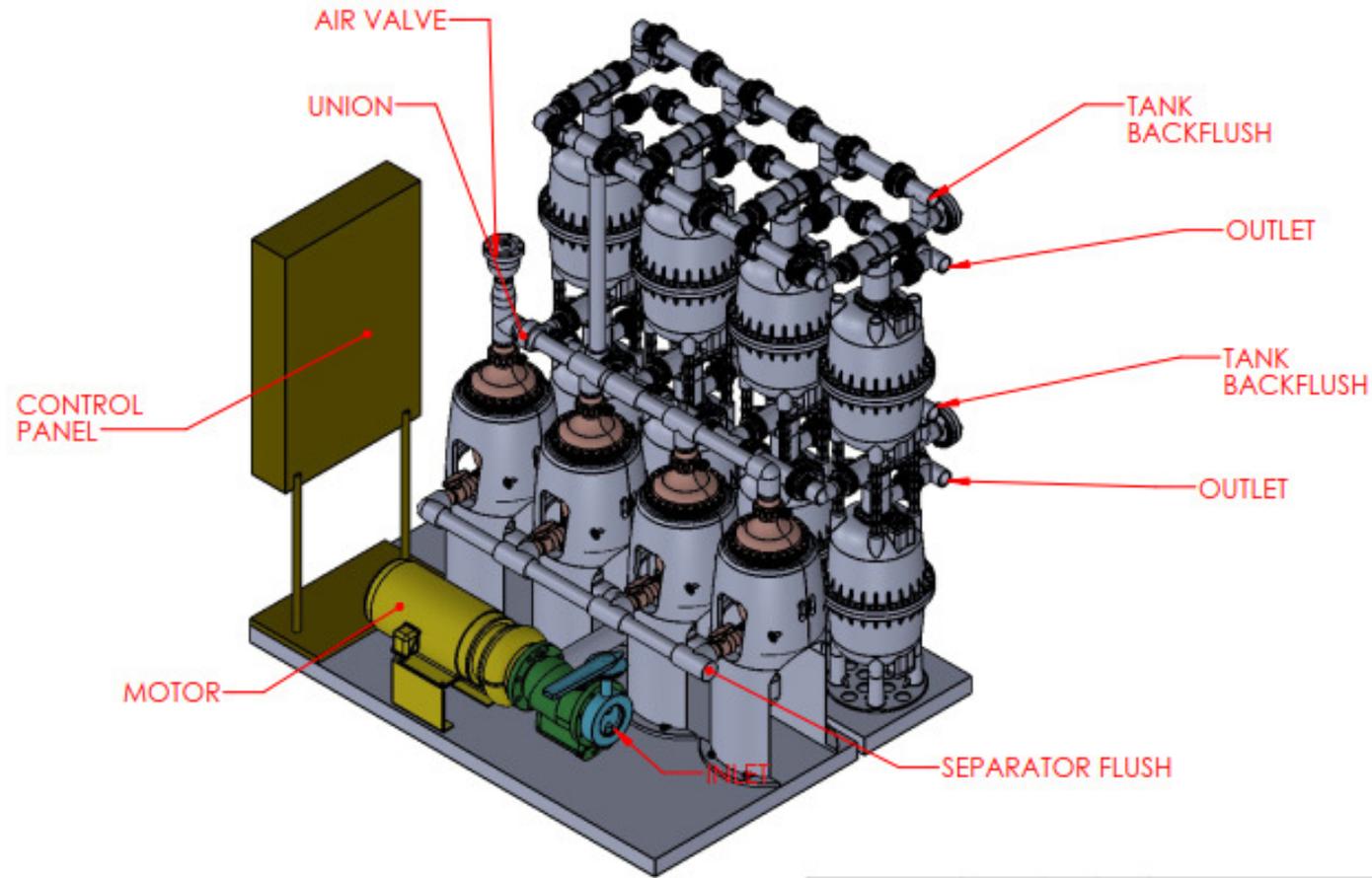
OFFER TWO SOLUTIONS

Stacked Media Filters

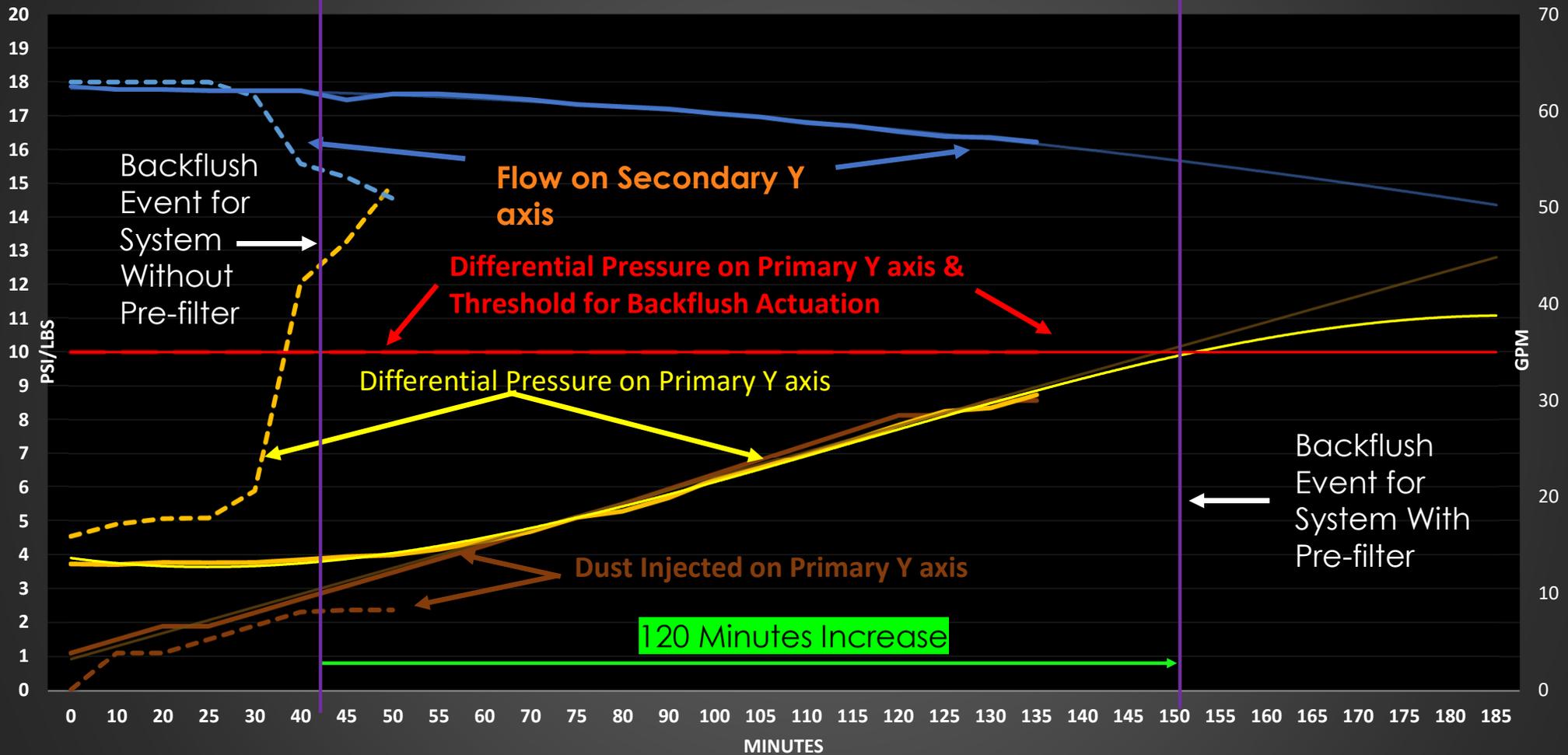
Silt Separators



TWO SOLUTIONS ONE PACKAGE INDUSTRY FIRST!



Media Filter Without & With Prefiltration



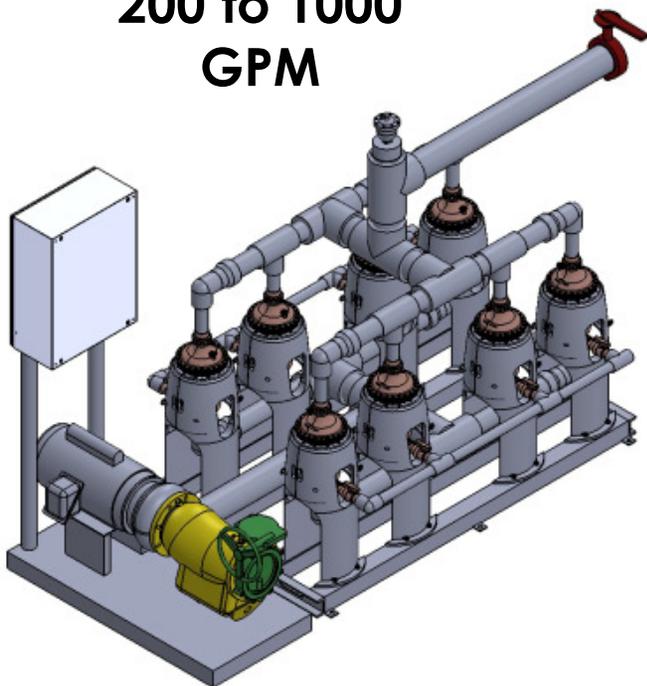
Increases period between flushes by as much as 5 times

— Poly. (MFP Pressure Differential (psi)) — Linear (MFP BackFlush (psi)) — Poly. (MFP Flow (GPM))

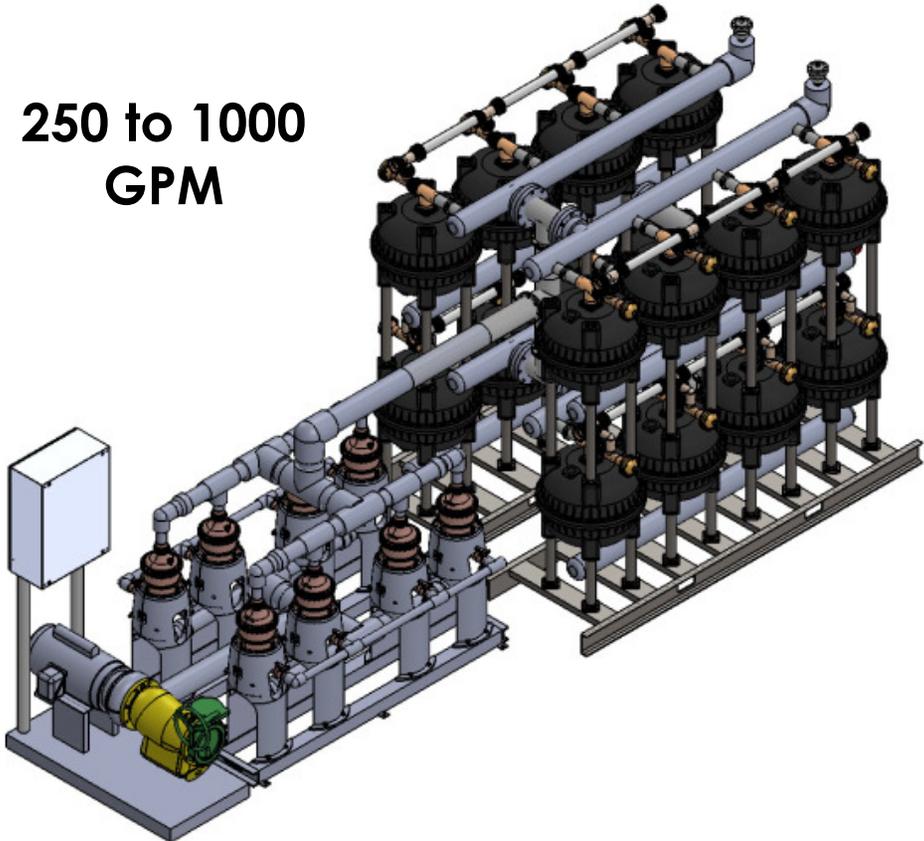


SCALABLE TO ANY FLOW ²⁵

200 to 1000
GPM

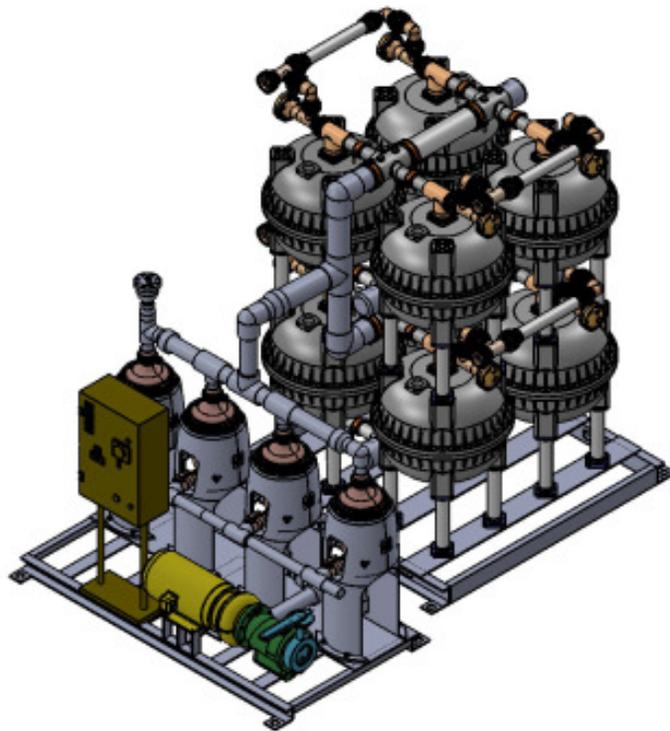


250 to 1000
GPM

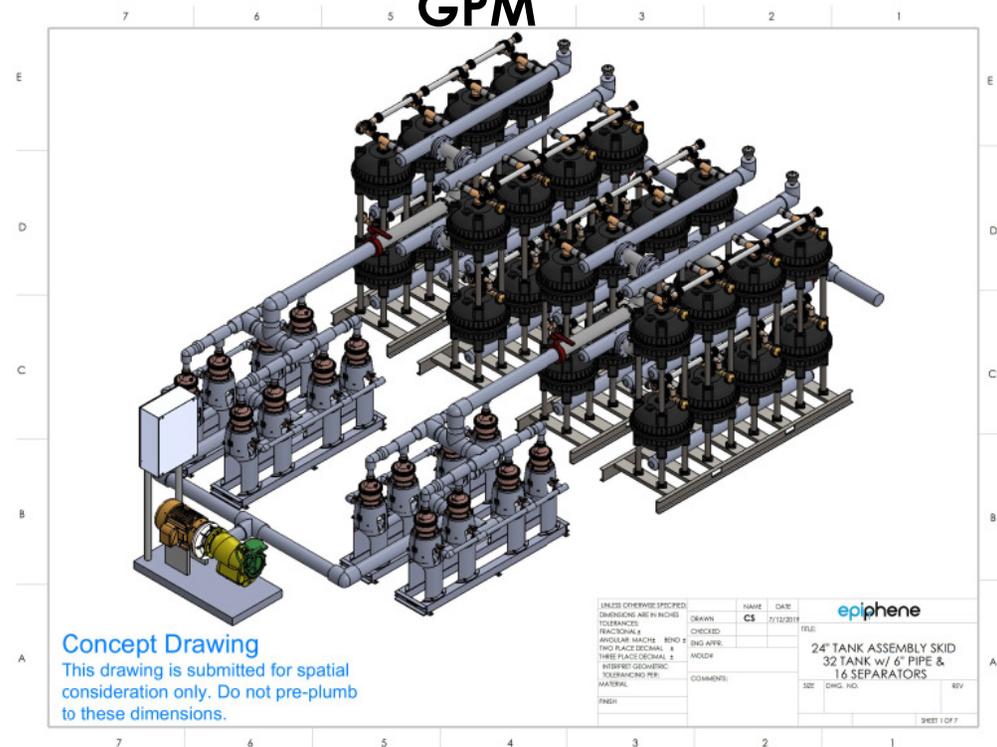


SCALABLE TO ANY FLOW ²⁶

100 to 500 GPM



400 to 2000
GPM



SUMMARY & QUESTIONS

- Performance
- Meet any conditions
- Modular
- Variable Flows Possible

