



Dryden Pool Academy SESSION 2

FILTRATION AND BACKWASH




**10
HIGH-LEVEL
TRAINING
SESSIONS**






1

AGENDA 9.30 – 10.30 am





9:30 Dryden Aqua short intro

9:35 Overview of the different types of filters and filter media


Filter hydraulics: The importance of the filter design


How to calculate filtration (and backwash) velocities

Filtration velocities and filtration performance

How to properly backwash a sand filter


10:20 Q&A : Questions / Answers



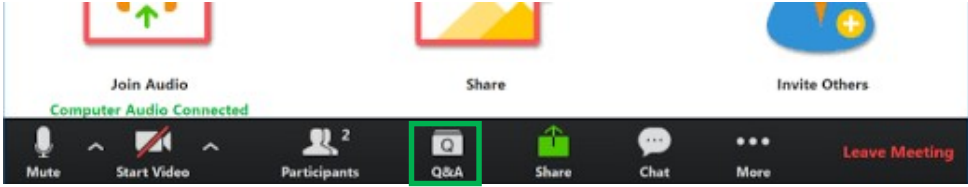


2

Questions & Answers

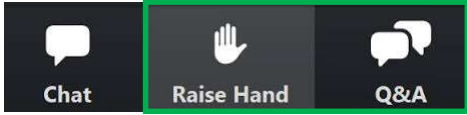


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POOL ACADEMY**
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Prepare and send us your questions during the meeting using the "Q&A" feature

Use "Chat" for suggestions and feedback



3

Dryden Pool Academy presentations and replays



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Replay available for 7 days after each session (EN, DE, FR, US)

Program



PDF Presentation available for download 24 hr before each session (every Thursday)



www.drydenaqua.com

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DRYDEN AQUA SUSTAINABLE WATER QUALITY

Hydraulics and filtration always first!

DRYDEN POOL ACADEMY KNOWLEDGE IS POWER!

GET YOUR PYRAMID RIGHT!

10% CHEMICALS pH & DESINFECTION

10% MAINTENANCE

20% FRESH WATER

60% FILTRATION, FLOCCULATION, BACKWASHING, HYDRAULICS

FILTRATION & HYDRAULICS FIRST

CHEMICALS pH & DESINFECTION

MAINTENANCE

FRESH WATER

FILTRATION

CHEMICALS FIRST

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DRYDEN AQUA SUSTAINABLE WATER QUALITY

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DRYDEN POOL ACADEMY

OVERVIEW OF THE DIFFERENT TYPES OF FILTERS & FILTER MEDIA

6

6



3 main types of pool filters



1



Sand filters

2



Cartridge filters


3




D.E filters




7



Sand filters...with sand (pros and cons)







1 **Sand filters**


Acceptable filtration performance
down to 20-30 microns

Easy to use / easy to clean



 Adapted to all types of pool water treatments
 Flocculation can be used => improves performance by a factor 10
 Suitable with hard and soft water


 Sand is subject to biofouling and channeling
 Needs high backwash velocity (significant water consumption)
 Limited lifetime: Sand should be replaced every 5 years


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Cartridge filters (pros and cons)




Filtration performance usually 50 microns



Easy to install, compact and cheap

No backwashing needed – low water consumption



Cartridges need to be washed frequently and replaced


Not great with hard water

No backwashing needed => NO FRESH WATER

OK for small pools & spas - Not for larger pools

Not suitable with coagulation / flocculation

Dissolved organics and phosphates cannot be removed



2

Cartridge filters

9



D.E filters (pros and cons)








3

D.E filters





High maintenance & high running costs!

- Backwash every 2 – 4 weeks
- Cleaning every 2 -4 months
- 0.5kg DE powder per m2 to be added after each backwash (8 – 16€)
- Filter elements must be replaced from time to time

Not suitable with coagulation

Dissolved organics and phosphates cannot be removed

10



Which filter media for your sand filters?







Institut de la Filtration et des Techniques Séparatives

Do they all offer the same filtration efficiency ?



Sand




Mixed & clear glass




AFM® ng
Activated : Increased hydrophobic surface





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IFTS Test results – Filtration velocity: 20m/h





AFM® 


1  **> 1 micron**

Sand 

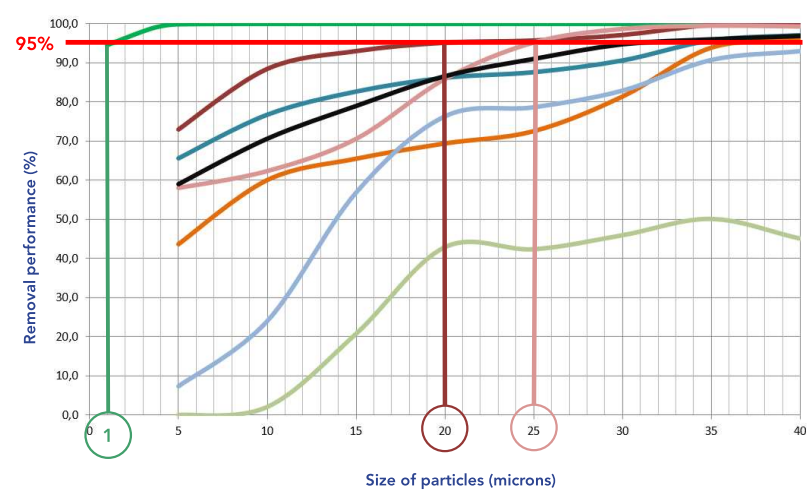
2  **> 20 microns**

Glass 


3  **> 25 microns**


 Full IFTS report available on drydenaqua.com

Particle size removal performance (without flocculation)




Size of particles (microns)	AFM® ng 1	Sand (0.5-1.0mm)	Garo	Astral	Bioma	EGFM	Vitrosphere	Nature works
1	100	-	-	-	-	-	-	-
5	100	~70	~65	~45	~10	~60	~0	~60
10	100	~85	~75	~60	~25	~65	~5	~70
20	100	~95	~85	~75	~50	~70	~45	~80
25	100	~95	~85	~80	~60	~75	~45	~85
30	100	~95	~85	~85	~70	~80	~45	~90
35	100	~95	~85	~90	~75	~85	~50	~95
40	100	~95	~85	~95	~80	~90	~45	~95



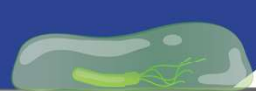



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SUSTAINABLE WATER QUALITY

Quick word about biofouling...







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Sand is subject to biofouling
Requests high backwash velocity
Loses filtration efficiency overtime
Variable quality




Metal oxides in green & brown glass
Less subject to biofouling
Usually requests less backwash water than sand
Variable quality




AFM® has a self-sterilizing surface
fully resistant to biofouling
Up to 50% less backwash water vs sand
No loss of filtration efficiency
Constant quality



Sand





Mixed glass



AFM® ng
Activated filter media

SESSION 4 & 5
FOR MORE INFO





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SUSTAINABLE WATER QUALITY

What about Activated carbon?



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Activated Carbon GAC



MADE FROM COCONUT SHELL

Coconut charcoal → **Activation** → Activated carbon

Increased surface area



Activated carbon is a form of carbon processed to have small, low volume pores that increase the inner surface area available for adsorption or chemical reactions. Activated carbon is hydrophobic.

 **Very efficient for the removal of combined chlorine (and THMs) in public indoor pools!**



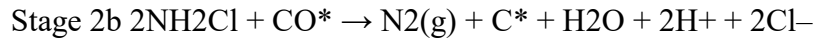
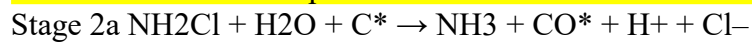
- Grain size: 0.6 to 2.4 mm
- Specific weight : 500kg / m3
- We recommend coconut-based GAC (does not contain iron)
- Very high Surface (BET): 900 - 1100m2/g
- Dechlorination half-length value: 10cm @ 30m/h filtration velocity
- Very low contamination risk if less than 10 cm of layer



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IFU: Instruction for use page 15

AFM® is used with activated carbon in combination with chlorine or other oxidising agents. The filter bed will usually be Grade 1 AFM® with a 50mm to a maximum of 100mm layer of activated carbon. It is very important not to use any more than 100mm of activated carbon, to prevent the carbon from becoming a biofilter. A small amount of activated carbon works well as a catalyst, but any more than 100mm could start to cause issues resulting from biofouling of the carbon. The mechanism by which chloramines are catalytically oxidised by activated carbon in the presence of chlorine are as follows:



The end products will be nitrogen gas, hydrochloric acid and water as well as carbon dioxide with organic matter.


Dryden Aqua

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15



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Activated carbon : High bed expansion

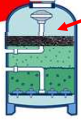


Bed expansion during backwash

Because it has a lower density than sand, expansion of the carbon layer may be as much as 50%.

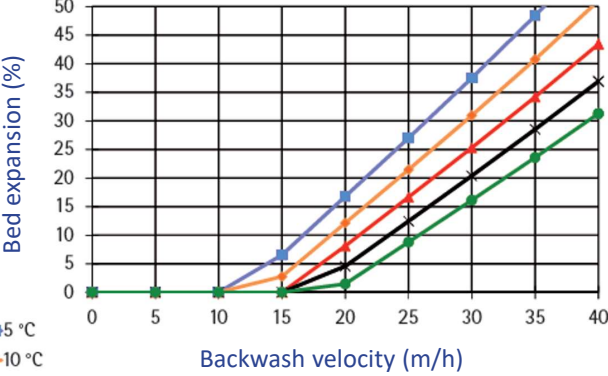
GAC must be soaked (put in water) for 24 hours before backwashing.
We recommend water wash only – no air wash

Make sure you have enough freeboard!




Water temperature

- 5 °C
- 10 °C
- 15 °C
- 20 °C
- 25 °C





Backwash velocity (m/h)	5 °C	10 °C	15 °C	20 °C	25 °C
0	0	0	0	0	0
5	0	0	0	0	0
10	0	0	0	0	0
15	5	2	1	0	0
20	15	8	4	2	1
25	25	15	8	4	2
30	35	22	12	6	3
35	45	30	18	10	4
40	50	40	25	15	6

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What about anthracite? Anthracite N vs H





NOT INTERESTING FOR POOLS



Anthracite N


Spec. weight 720kg/m³
Grain sizes: 0.8 – 1.6 or 1.4 – 2.5mm
Based is stone coal

It is not thermal activated

Has no adsorption capacity

Surface is not porous

Is only used for room filtration



NEEDS 3x MORE DEPTH THAN ACTIVATED CARBON

Anthracite H


Spec. weight 500kg/m³
Grain sizes: 0.8 – 1.6 and 1.4 – 2.5mm
Based on brown coal - thermal activated

Surface (BET) 300m²/g (3x lower vs Activated carbon)

Dechlorination half-life length: 30cm @ 30 m/h filtration velocity

Is used for THM and combined chlorine reduction

Can contain iron!!!



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Conclusion: DAISY – Public indoor pool
If you need to be < 0.2mg/l of combined chlorine

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FlowVis

VS Pump

ZPM

APF Pools

APF

Activated carbon

AFM

5 - 10 cm

5 - 10 cm on top of the filter bed in replacement of AFM

SESSION 8
MORE INFO ABOUT COMBINED CHLORINE

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FILTER HYDRAULICS:
THE IMPORTANCE OF THE FILTER DESIGN

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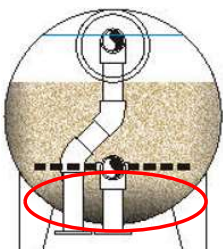
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The importance of the filter design

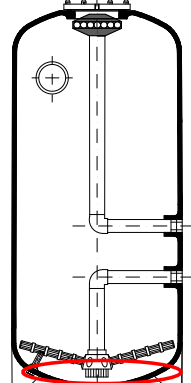


1 Horizontal filters



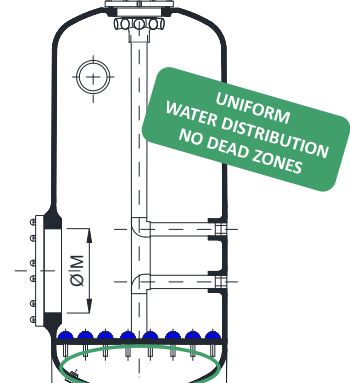
Poor

2 Vertical filters with laterals



Better

3 Vertical filters with nozzle plate



Best

UNIFORM WATER DISTRIBUTION
NO DEAD ZONES

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Laterals design and backwash performance
What comes in during filtration must come out during backwash!!!



PROPER DESIGN



PROPER & UNIFORM BACKWASH




IMPROPER DESIGN



"DEAD ZONES" NEVER PROPERLY BACKWASHED

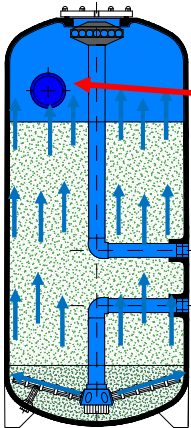



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Laterals design comparison => Backwash performance
What comes in filtration must come out in backwash!!!


PROPER DESIGN

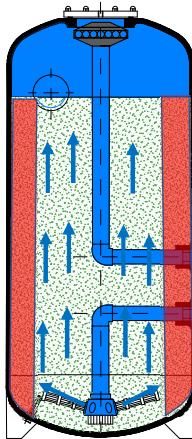
What happens in the filter?

IDEALLY USE A SIGHTGLASS TO CONTROL BED EXPANSION


IMPROPER DESIGN



"DEAD ZONES" NEVER PROPERLY BACKWASHED




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Filter design and backwash performance
What comes in during filtration must come out during backwash!!!

Good quality filters have good internal hydraulics




Blue filter, good hydraulics, good performance





Red filter, poor hydraulics, poor performance
Would you have seen it without a sightglass??



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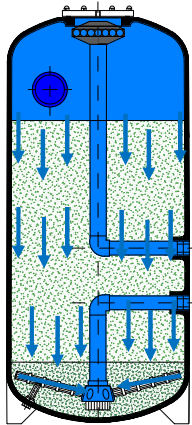
What about filtration performance?

Reduced filter surface = Reduced filtration performance



PROPER DESIGN

PROPER WATER DISTRIBUTION
NO LOSS OF FILTER SURFACE



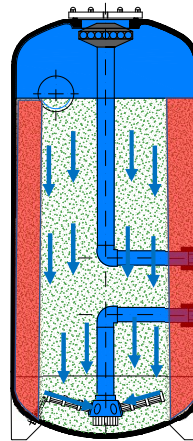
FLOWRATE: 36m³/h
DIAMETER \varnothing 1260 mm
FILT SURF 1,2 m²

VELOCITY: 30 m/h

Works as expected

IMPROPER DESIGN

IMPROPER WATER DISTRIBUTION
LOSS OF FILTER SURFACE



Paying for a \varnothing 1260mm filter
but getting a \varnothing 1000mm filter!!

FLOWRATE: 36m³/h
REAL DIAMETER \varnothing 1000 mm
FILT SURF 0,8 m²

VELOCITY: 45 m/h

The system does not work as expected

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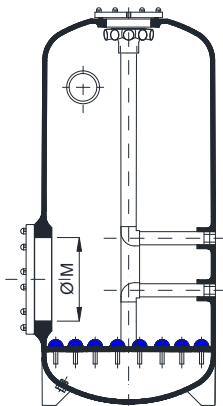


Same rule applies for nozzle plate beds!



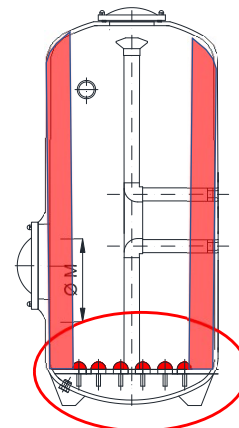
PROPER DESIGN

EQUAL WATER DISTRIBUTION
PROPER & UNIFORM BACKWASH



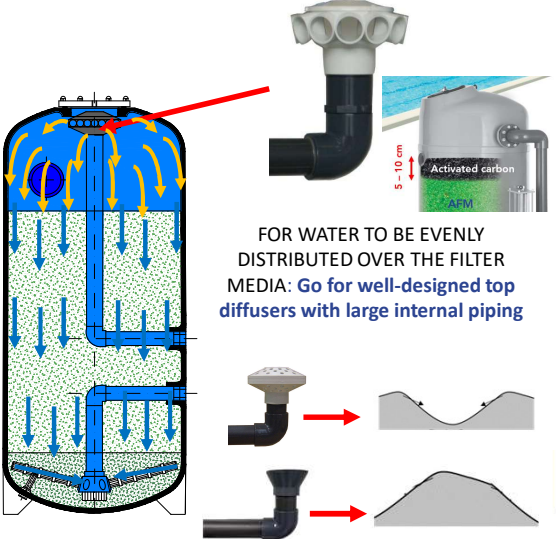
IMPROPER DESIGN

"DEAD ZONES" NEVER
PROPERLY BACKWASHED



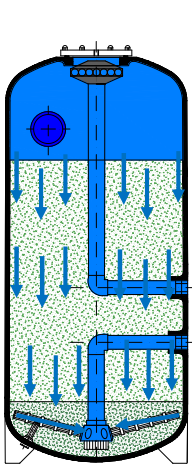
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Top diffusers => Straight filter bed




FOR WATER TO BE EVENLY DISTRIBUTED OVER THE FILTER MEDIA: Go for well-designed top diffusers with large internal piping

Activated carbon
5 - 10 cm




The higher the bed depth the better the filtration

Filter bed depth may range from 300mm to 3000mm, if the filter complies to German DIN, it will have a bed depth from 1200mm to 1400mm





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HOW TO CALCULATE FILTRATION AND BACKWASH VELOCITIES

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Calculate filtration and backwash velocities



V: Filtration & Backwash velocity : measured in m/h (m³/h/m²)
F: Filter surface area = (Radius x Radius x 3.14): m²
Q: Flowrate: m³/h


1. Filtration speed m/h (m³/h/m²): **Q / F = V**
 ex. 10m³/h / 0.3m² = 33m/h

2. Flowrate m³/h : **V * F = Q**
 ex. 33m/h * 0.3m² = 10m³/h


3. Filter surface area (m²): **Q / V = F**
 ex. 10m³/h / 30m/h = 0.33m²

Recommended filtration speed : 15 - 30 m/h

Recommended Backwash speed
 Sand : 60 m/h
 AFM : > 40 m/h



Use a VS Pump



Use a Flowmeter

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Pick the right filter!



Flowrate m³/h / Filter surface (m²) = Filtration speed (m/h)

Example : 50 m³ private pool
Turnover rate : 5 hours
=> Flowrate : 10 m³/h







50m/h +50 - 200€ 33m/h

Which filter diameter ?


Ex. 10m³/h / 0.2m² = 50m/h – Filter d520mm – 650€ / 848€

Ex. 10m³/h / 0.3m² = 33m/h – Filter d640mm – 808€ / 987€

Ex. 10m³/h / 0.4m² = 25m/h – Filter d720mm – 1195€ / 1164€


SMALL DIFFERENCE IN PRICE
HUGE DIFFERENCE IN PERFORMANCE

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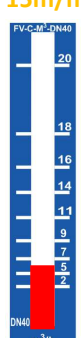
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SUSTAINABLE WATER QUALITY

Use a VS pump and a flowmeter



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15m/h




15m/h

Night

1

30m/h

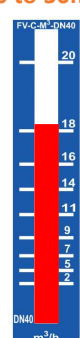


30m/h

Day

2

40 to 50m/h




40 to 50m/h

Backwash



3

Know the flow!



Set your VS pump the right way

- ⇒ Perfect filtration & backwash
- ⇒ Best water & air quality
- ⇒ Reduced Energy, chemical and water consumption!
- ⇒ Everything under control!


+


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SUSTAINABLE WATER QUALITY



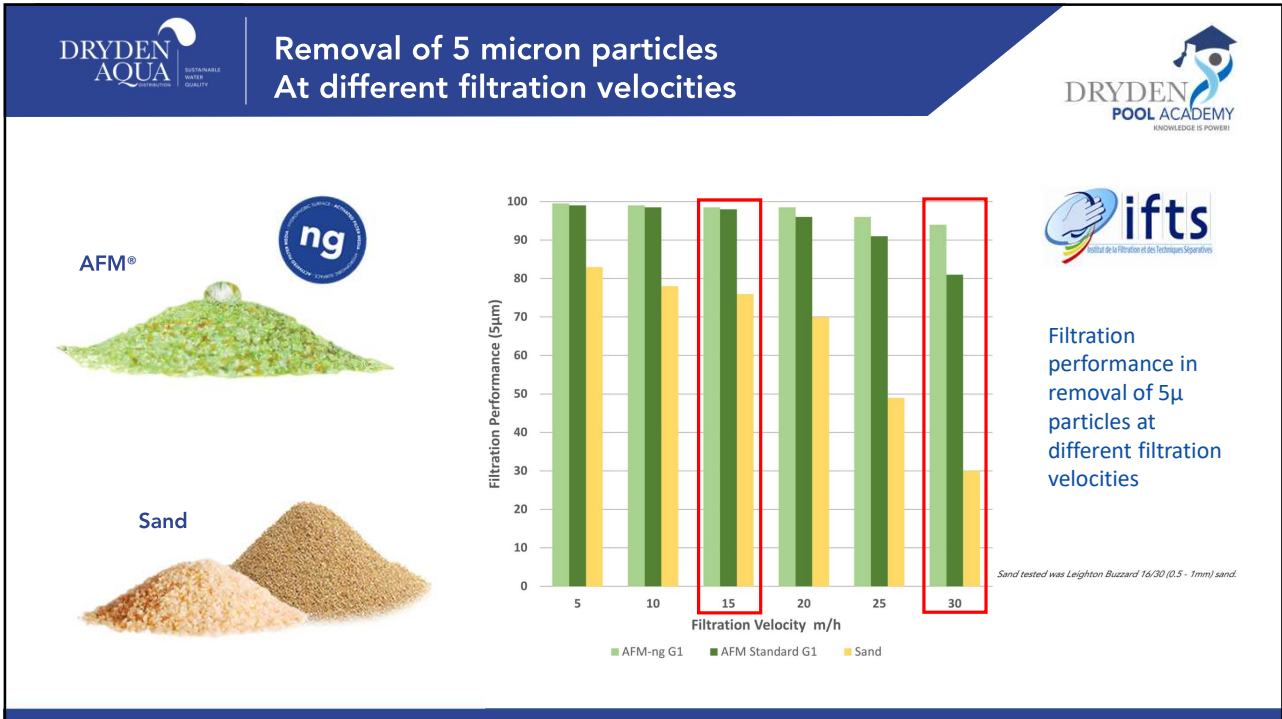
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KNOWLEDGE IS POWER!

DRYDEN POOL ACADEMY

FILTRATION VELOCITIES
FILTRATION PERFORMANCE HOW TO PROPERLY BACKWASH A FILTER




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Recommended bed expansion

The minimum backwash velocity should expand the bed by 15%.


Minimum => 15%
Best (recommended) => 25%

With Sand
You need a velocity of 50 - 60 m/h:
Duration: 5 - 6 minutes


With AFM[®] :
You need a velocity of > 40 m/h:
Duration: 3 - 5 minutes
Approx. 50% less backwash water is needed


ifts

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Fast & short is better than slow & long





Backwash at 60 m/h (=> 1 min = 1m)
For 2 meters => **2 minutes**

Backwash at 50 m/h (=> 1 min = 0.83m)
For 2 meters => **2,4 minutes**

Backwash at 40 m/h (=> 1 min = 0.65m)
For 2 meters => **3 minutes**

Backwash at 30 m/h (=> 1 min = 0.5m)
For 2 meters => **4 minutes**

We need the speed to expand the filter bed
but we also want the particles to get out of the filter!!


Example
At 60m/h => 2 minutes to get to the top + 50% to remove particles out => 3 minutes
At 30m/h => 4 minutes to get to the top + 50% to remove particles out => 6 minutes

=> same amount of backwash water used
=> Better results with 60m/h => higher speed is better to remove heavy particles out of the filter


Example public filter

Distance between nozzle plate and diffuser => 2 meters


WHEN IT COMES TO BACKWASH
=> FAST & SHORT IS BETTER
THAN SLOW & LONG




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Why a proper backwash is so important?





Material removed in backwash does not have to be oxidised:



No chemical demand
↓ Cl




No disinfection by-products
↓ DBPs


Poor backwash

Biofouling
Clogging
Channeling
More chemicals
More DBP's
...

How a backwash should look like




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SUSTAINABLE WATER QUALITY


Backwashing some crushed glass can be very difficult...




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Some crushed glass on the market are highly polluted from the start and do not backwash well

- The backwash velocity also depends on the particle shape & size distribution, uniformity coefficient and density of the media

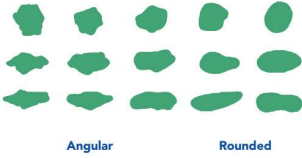


Random crushed glass at a 50m/h backwash!



Brand new glass after multiple backwashes!


High Sphericity



Low Sphericity


Angular Rounded

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SUSTAINABLE WATER QUALITY

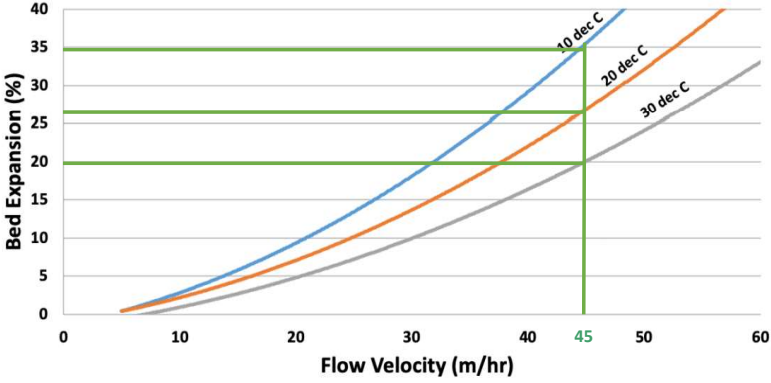
The influence of water temperature



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Temperature impacts strongly on bed expansion.

- The higher the temperature the less the bed expansion
- The higher the temperature the higher the backwash velocity needs to be.



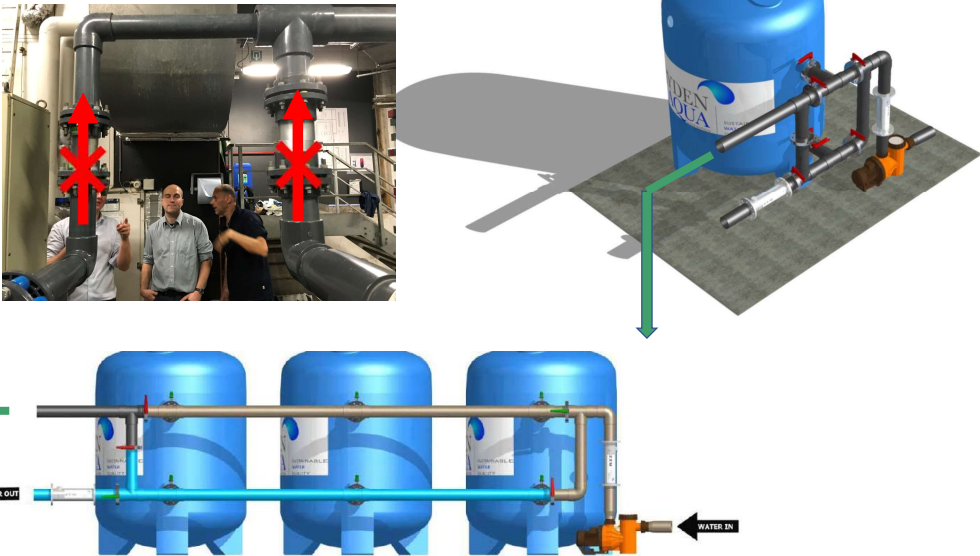
Flow Velocity (m/hr)	10 dec C Bed Expansion (%)	20 dec C Bed Expansion (%)	30 dec C Bed Expansion (%)
0	0	0	0
10	~2	~1.5	~1
20	~5	~3	~2
30	~10	~5	~3.5
40	~18	~9	~5.5
45	~25	~13	~7.5
50	~35	~18	~10
60	~45	~25	~13.5

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Never go up – ALWAYS GO DOWN!

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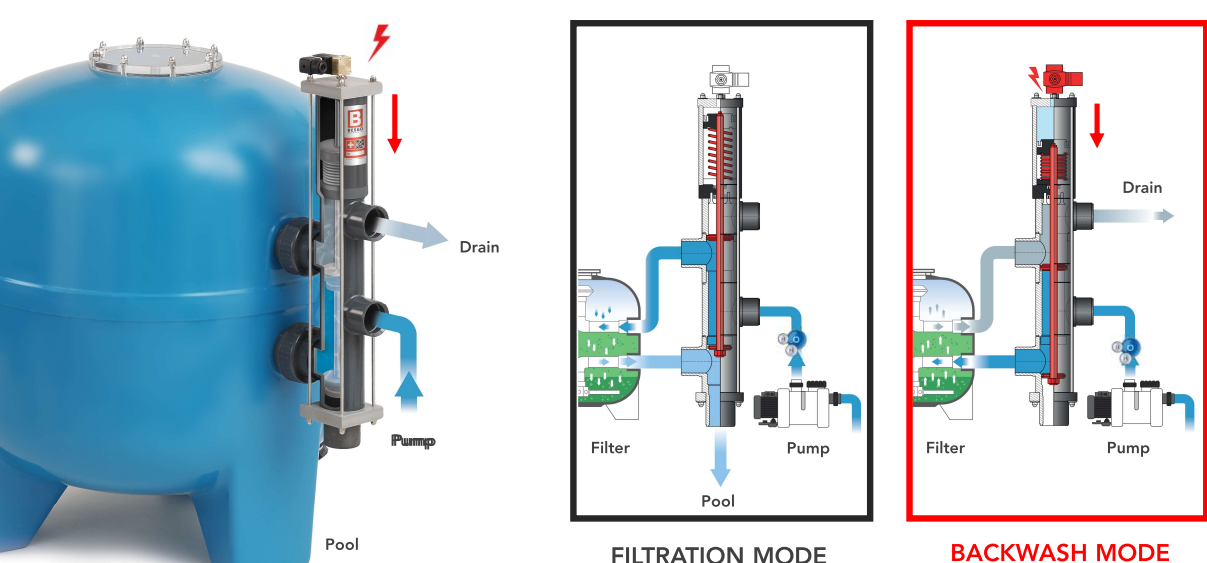


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DRYDEN AQUA SUSTAINABLE WATER QUALITY

Besgo Automatic backwash valves

BESGO SWISS QUALITY



Pool

Drain

Pump

Filter

Pool

Pump


Filter

Pump


FILTRATION MODE

BACKWASH MODE


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SAFE & EASY




BESGO
SWISS QUALITY



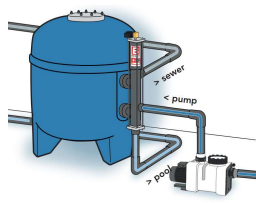
High installation flexibility:
Can be fitted directly on the filter or mounted on a wall (90° rotating connections)



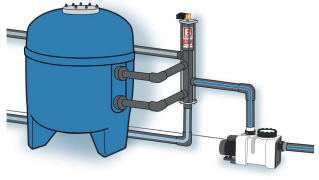
Very safe to operate:
The valve returns automatically to "Filtration mode" in case of electrical failure.



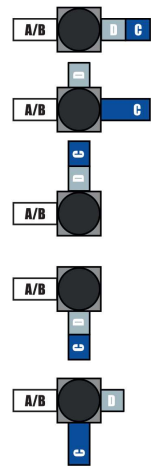
Fast switchover: The filtration pump does not have to be stopped during the switchover.




Fitted directly on the filter




Mounted on the wall




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LOWER PRESSURE DROP!

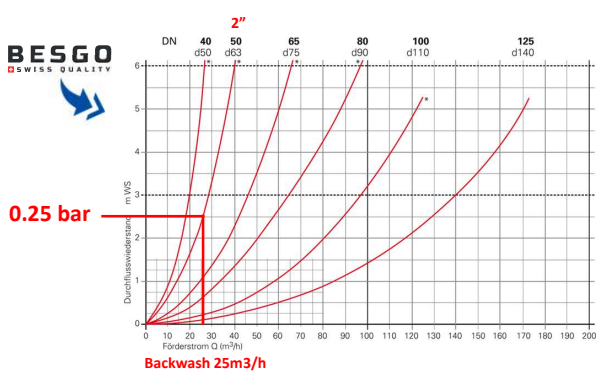


BESGO
SWISS QUALITY



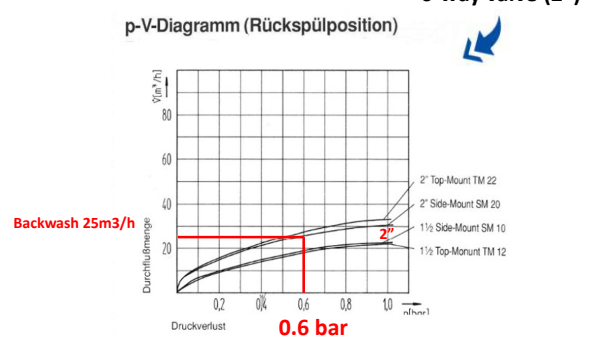
Low pressure drop: Offers higher backwash velocity & efficiency than traditional 6-way valves.

Example Filter ≈ Ø800mm
 Filter surface : 0.50 m²
 Backwash velocity : 50m/h
 Backwash flowrate : 25m³/h



Backwash 25m³/h

6-way valve (2")



Backwash 25m³/h

0.6 bar

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Finally, pay attention to pipe connection diameter



With the 1.2m \varnothing Chinese filter in the picture:

- pipe connection \varnothing are DN50 (63mm)
- Backwash velocity 45m/h \Rightarrow flowrate 50m³/h
- pipe velocity at 50m³/hr is 7m/s!!
- Too small diameter \Rightarrow Too high resistance

...backwash is impossible!

JOIN SESSION 3
FOR MORE INFO



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FEBRUARY 5th 2021

zoom



SESSION 3 : PIPING & OVERFLOW POOLS

- Well dimensioned hydraulics in overflow pools
- Pipe diameter calculation - the magic Dryden ruler
- Overflow pools: Determination of a properly sized balance tank
- How to backwash an overflow pool best
- Eco Mode: How to reduce energy consumption in all overflow pools



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Questions / Answers

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