FLUIDRA

POOL FILTRATION:

all you need to know
for public pools

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01 FILTRATION: THE KEY TO CLEAN, SANITIZED WATER

Managing to get **water** totally crystal **clear and sanitized** is one of the keys to any water facility as well as keeping bathers satisfied, in addition to complying with the laws in force.

Thus, **filtration and recirculation systems** are core components of a pool's cleaning equipment.

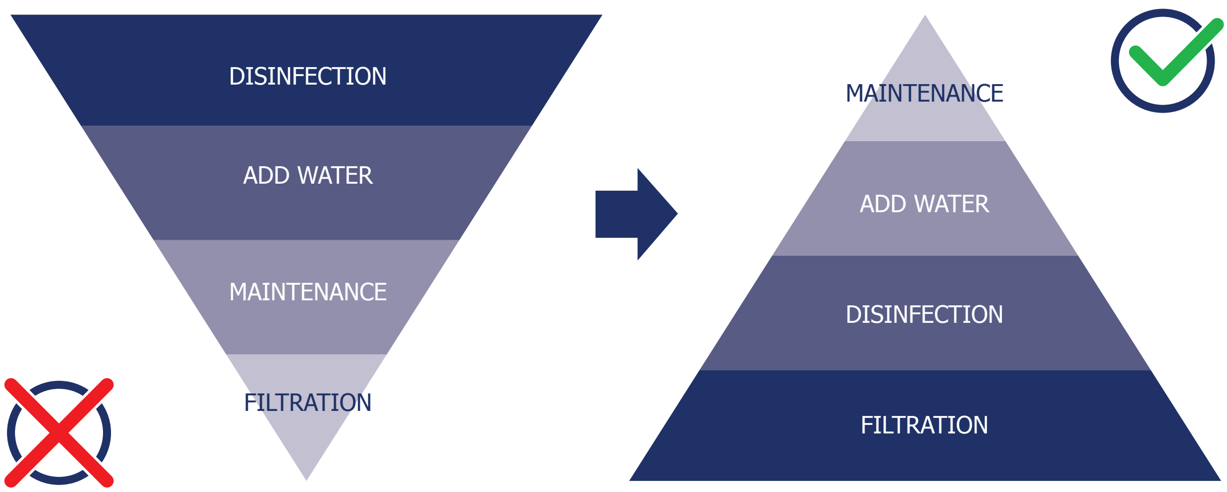
They are rather like the kidney in the human body, as these systems serve to separate and remove impurities found in the body of water.

Moreover, the **most advanced filters** currently available not only ensure the water is kept clean, but also deliver **efficiency** unheard of until now in terms of sustainability and savings.

Rational use of chemical products in filtration systems

Keeping pool water as sanitized as possible and looking good inevitably involves using chemical products.

Mitigating the damage caused by chemicals means **prioritizing filtration** (or physical treatment), which enables chemical treatments to be kept to a minimum, so that they are only used to deal with issues not resolved by filtration.



Water recirculation rate for efficient, sustainable filtration

Water reuse and recirculation systems allow **reduced water consumption** and result in **energy savings**.

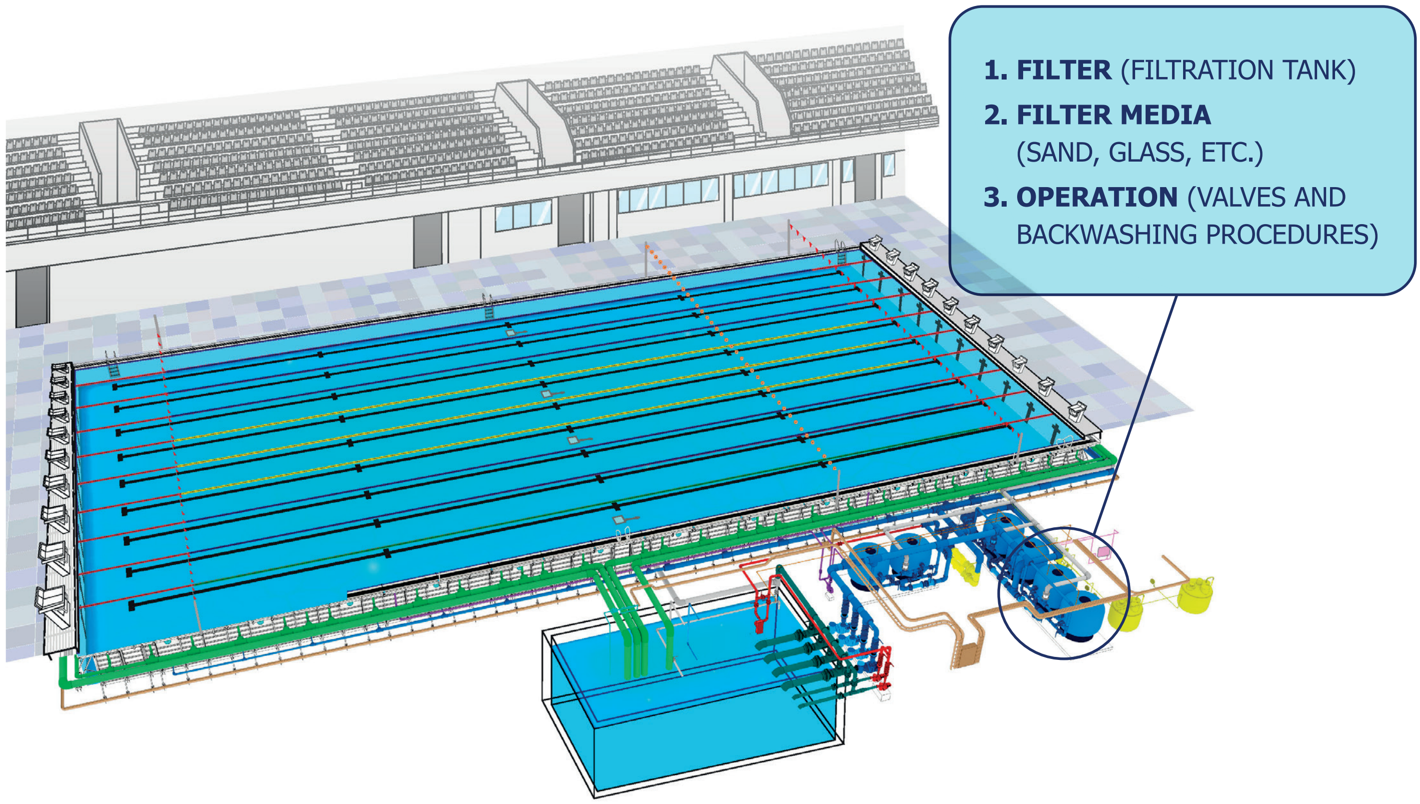
Their aim is to keep the **water transparent** and to give it a thorough **physical and chemical treatment**. To do so, they collect the contaminated water so that it can be filtered and disinfected, and then return it to the pool basin.

In addition, they have the following advantages:

- They thoroughly **circulate the water** in such a way that "dead spots" are avoided and ensure that the whole of the surface water is recirculated.
- They achieve an **even distribution** of disinfectants and other products.

"Water reuse and recirculation systems allow reduced water consumption and result in energy savings."

02 EFFICIENT POOL FILTRATION SYSTEMS: THE FILTER



Types of filter

Building materials for the tank and external housing:

- **Steel (carbon-reinforced or stainless):**
  Now rarely used, it is also very costly.
- **Thermoplastic:**
  This is the ideal choice for small and residential pools, and is available in the following options:
  - **Injection-molded plastic:** This enables sophisticated designs to be made, but allows for fewer mechanical features compared to GRP.
  - **Blow-molded:** As a cheaper alternative, it is less resistant in comparison with injection-molded plastic or GRP.
  - **Roto-molded:** Ideal for short production runs and highly customizable, it is more costly and has less mechanical strength in comparison with GRP.

- **Glass-fiber reinforced plastic (GRP):**
  Ideal for commercial pools, it is now the most commonly used material due to its high **chemical and mechanical resistance** and longer **service life**. It also makes it possible to do short, customizable production runs at competitive prices.

Filter finishes

- **Bobbin-wound**: Manufactured using glass-fiber reinforced plastic, which is completely anti-corrosive, it delivers high mechanical, chemical and thermal resistance.
- **Laminated:** Manufactured using the simultaneous spray-up of resin and fiberglass.
- **Fiberglass:** as it is totally resistant to corrosion, this is the best choice for the pre-treatment of salt or briny water in reverse osmosis processes. With an interior barrier coating of isophthalic resin that is bobbin-wound on the outside with GRP (according to standard UNE-EN 13121), filters can be designed with a collector system, cylindrical in shape and with connections as per requirements.

03 FILTRATION PROCESS

Choice of filter

Mechanical filtration consists in trapping contaminating particles when the water passes through the filter.

The different layers of the filter media that make up the filter bed come into play at this stage to deposit particles inside the filter.

The variables shown below are taken into consideration in the design of this filtration system.

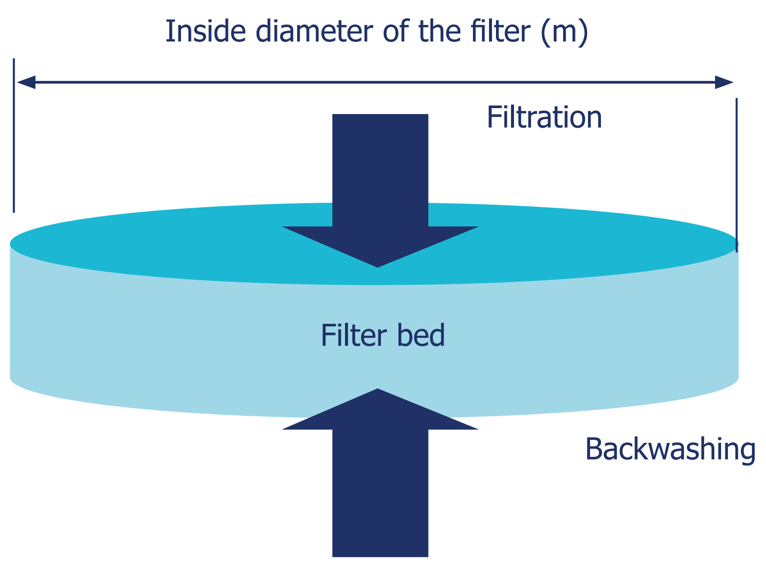
- The **filter media**, which can be sand, glass, anthracite or zeolite.
- The **filtration rate**, whose formula is:

  Filtration velocity, where v = the volume of water that flows through the filter (m^3) [Cross-section of the filter media (m^2) · T (hours)].

Although this can also be expressed as:

Filtration velocity, where

v = flow rate (FR) (m^3/hour/Filtration surface area (m^2) = m/h



Filtration surface area (m^2) = 3.14 x (Diameter/2)^2

Image: The filtration surface

- The **turnover rate** is the time it takes for the whole of a pool's water volume to pass through the filtration system.

  The choice of turnover rate must be evaluated by the designer based on the laws in force, the characteristics of each pool (use, environment, capacity, etc.), the amount of water to be filtered and the filter media to be used (who should also recommend a specific turnover rate in her/his technical specifications).

- The **filtration flow rate**, namely, the ratio between the pool volume and turnover.

An **example** of a filtration system design is given below.

- The hypothetical pool is 12 x 25 m and 1.5 meters deep, whose volume is therefore 450 m^3.
- The turnover selected is 3 hours (i.e., the whole volume of the pool water will pass through the filtration system every 3 hours).
- In this case, the filtration flow rate, i.e., the FR of 450 m^3/3 hours = 150 m^3/h.

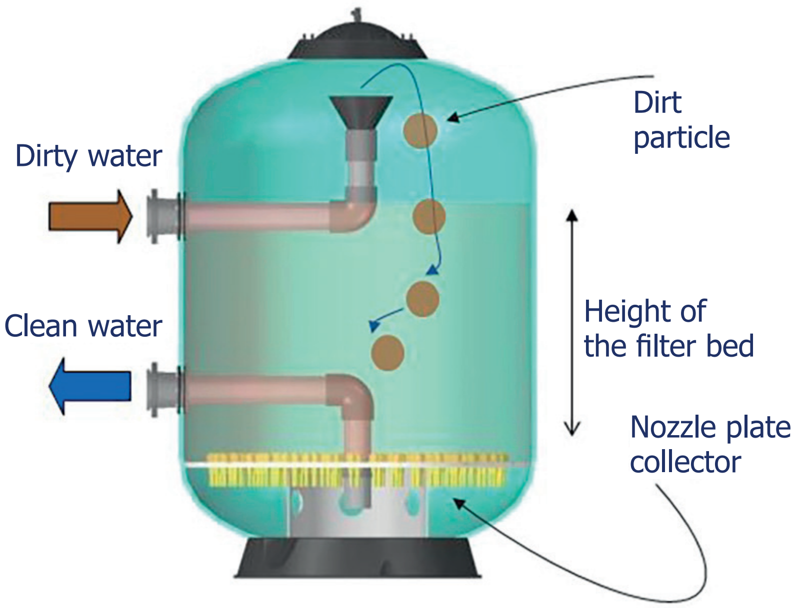


Image: Pathway of a dirt particle inside the filter

To choose the right filtration speed, as discussed above, the **laws in force** and the **characteristics** of the design must be taken into account:

- The usual speed in public pools is from 20 to 40 m/h.
- The speed in residential pools can be as high as 50 m/h, if the filter media used allows this.

For our case study, the filtration flow rate selected is 30 m/h.

Thus, the **required filtration surface area** obtained from the quotient between the filtration flow rate in m^3/h and the filtration velocity in m/h is:

- Filtration surface area S = 150 m^3/h / 30 m/h = 5 m^2

The calculation made up to this point can be summarized in a single equation:

> S (filtration surface area in m^2) = V (pool volume in m^3) / [T (*turnover in hours*) · v (filtration velocity in m/h)].

Other key aspects in the design of a filtration system include:

- One or various filters must be chosen whose total filtration surface area is 5 m^2 or more. It is recommended that **two filters be used** to avoid stoppages due to maintenance work and to ensure minimum filtration quality.

  For this case study, two 2.5 m^2 filters will be chosen (i.e., two filters with an internal diameter of 1,800 mm with a 2.54 m^2 filtration surface area each.

- The filter media selected will determine the **height** of the filter bed required. In public pools, the usual height of the filter bed is between 900 and 1,200 mm, whilst in residential pools it goes from 300 to 800 mm.

In any case, local regulations should be taken into account to calculate these values.

The filter media

The most common choice is a layer of **silica sand** with the following characteristics:

- Choice between two types of **packaging** formats, namely, bags of up to 25 kg and big bags of 1,000 kg.
- To a large extent, the **granule size** determines filtration efficiency. The smaller the granule, the greater the capacity to trap particles of dirt but it clogs up more quickly, as a result of which it has to be backwashed more often.

  The most common granulometries are 0.4–0.8 mm. Other typical sizes range from 0.45 to 0.7 mm and 0.45 to 0.55 mm, with different proportions of each granule size.

In addition, silica sand must be placed on top of an underlayer of **gravel**. Thicker than the sand and with no filtration capacity, it serves several purposes:

- As it is heavier than the sand, it acts as a **barrier**, thus preventing the sand from reaching the collector system and collapsing it.
- It helps **distribute** the water during backwashing.

Image: Filter and filter bed

In general, just one type of gravel with a granulometry of 1–2 mm will suffice. However, different granulometries can be used, in which case they should be layered from the smallest to the largest in descending order.

- If the option of a single underlayer of gravel with a granulometry of 1–2 mm is chosen, it should be 10 cm thick above the collectors.
- If two underlayers are used, the first should have a granulometry of 1 to 2 mm and the second from 3 to 5 mm.
- If three underlayers are used, the first should have a granulometry of 1 to 2 mm, the second from 2 to 3 mm and the third 3 to 5 mm.

Underlayers with a granulometry greater than 5 mm could damage the collectors.

The **average height of the filter media** is also of great importance, as the dirt is dragged from the top to the bottom by the flow of water. Thus, the greater the height, the greater the likelihood that particles of dirt will be trapped. Moreover, the greater the height, the less frequent the need for backwashing.

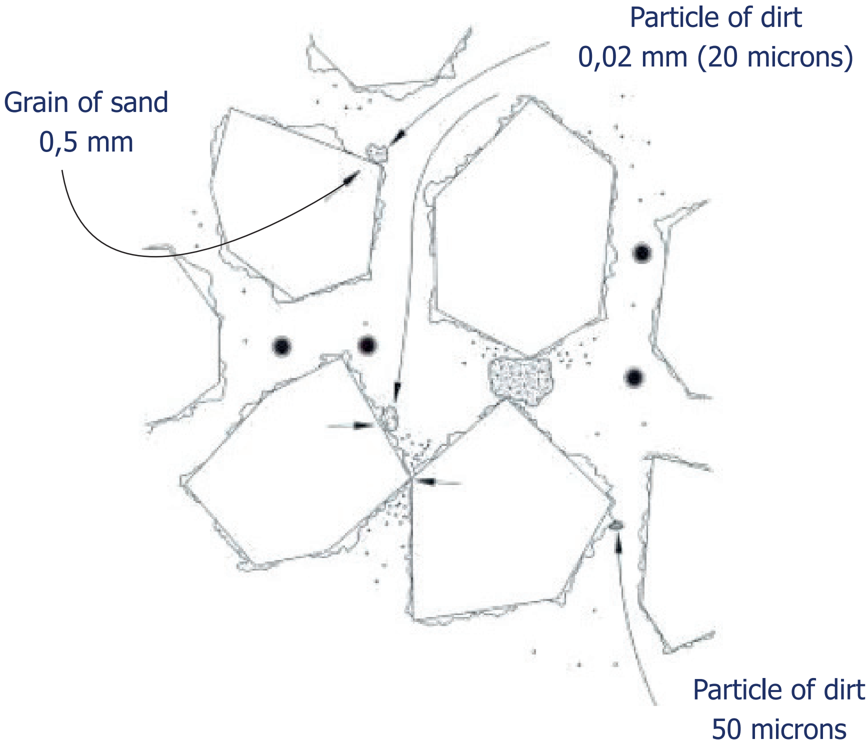


Image: Filtration mechanism in a granule media

The two most common filter bed heights are:

- Between 250 and 600 mm (depending on model) for flint sand filters used in residential pools.
- From 800 to 1,200 mm for filters in public pools. This option makes it possible to combine two different types of filter bed and to set up multilayer systems.

There are other types of filter media, including:

- **Anthracite and silica sand.** Anthracite (less dense but with a greater granulometry) is placed on top of the silica sand, in a proportion of 40 to 60% of anthracite, with a height of at least 600 mm. The gravel is placed on the bottom.

The largest particles are trapped, allowing the smaller ones to seep through towards the sand. The dirt is thus spread into two layers, which prevents it from building up in the first stretch of sand (as usually happens in a single layer).

The time between backwashes is thus longer and, therefore, water savings can be made.

- **Glass.** Its main advantage is the better distribution of trapped dirt, which spreads across the whole of the filter bed, thus reducing the effect of clogging in the first stretch. This translates as longer times between backwashes. The working pressure also is reduced, as the glass filtration media has a lower head loss compared with silica sand.

  There are different granulometries and trademarks in the market. The product datasheet will recommend the most suitable combination of granulometries, heights, filtration velocity and backwashing speed.

- **Zeolite:** this naturally occurring porous material filters better than sand, is long-lasting and available at reasonable prices.

The **design of the filtration tank** (shape, height and distribution of collectors and diffusers) also has a direct impact on the flow of water during filtration and backwashing.

Types of filter media

Flint sand

Flint gravel


Anthracite


Glass


Zeolites


OC-1

The **OC-1** solution is a combination of media and filters that delivers excellent results in both public pools and spas. Unlike many traditional methods that work by trapping particles, OC-1 works on the principle of settlement, which means that sediment is deposited on the OC-1 cells at the bottom, instead of remaining trapped on top of the filter media. The cleaning frequency is reduced and energy can be saved thanks to the use of a smaller pump that can be run at slower speeds. The filter can also be backwashed, which saves on water consumption.

Filter bed	Dirt trapped (energy consumption)	Backwashing frequency
Higher (minimum of 1 m but 1.2 m even better)	Greater likelihood of shock and sedimentation -> The dirt is not let out and does not return to the pool -> **energy is not wasted in vain**	Lower frequency because there is more room for dirt and it takes longer to reach the pool bottom -> **less water consumption**
Single layer: only flint sand	The top area of the bed gets much dirtier than the bottom area. The top area collapses (increased pressure) earlier than it should -> **more water and energy consumption**	
Multilayer: anthracite + flint sand	The anthracite traps the biggest particles and the flint sand that is under it traps the smaller ones so that the time between backwashes is longer and the head loss is reduced due to the collapse of the filter media -> less water and energy consumption The dirt is better distributed across the whole depth of the filter media so there is less head loss -> **less water and energy consumption**	
Glass filter media	The dirt is better distributed across the whole depth of the filter media so there is less head loss -> **less water and energy consumption**	
Others	Make sure they deliver what they promise	

Backwashing

Backwashing consists in **making a current flow** upwards, thus sweeping away the particles of dirt trapped in the filter media to later remove them.

The filter media's datasheet should be consulted to work out the **height** and load of the filter media, as an excessive load could surpass the level of the diffuser and be drained off. An additional safety distance should be allowed between the surface of the filter media and the diffuser.

Backwashing with water

Backwashing can be performed using water from the pool or the balance tank or by recirculating the filtered water back to the filter to be backwashed.

- The **frequency** depends on the filter head loss, which is calculated by subtracting the highest pressure reading from the lowest displayed on the gauges. If the result is greater than 0.6 bar, backwashing is recommended.

  If, after one or two weeks, the head loss does not exceed 0.6 bar, backwashing is recommended **every two weeks**. Some pools (such as indoor training pools) may only require a backwash **once a month.**

  A good practice is to backwash **more frequently** but for a **shorter time**, thus reducing power consumption and keeping the filtration flow rate stable.

  The pool operator should be the person who sets the frequency, the maximum load allowed and the length of backwashes, which may be adjusted at will according to requirements.

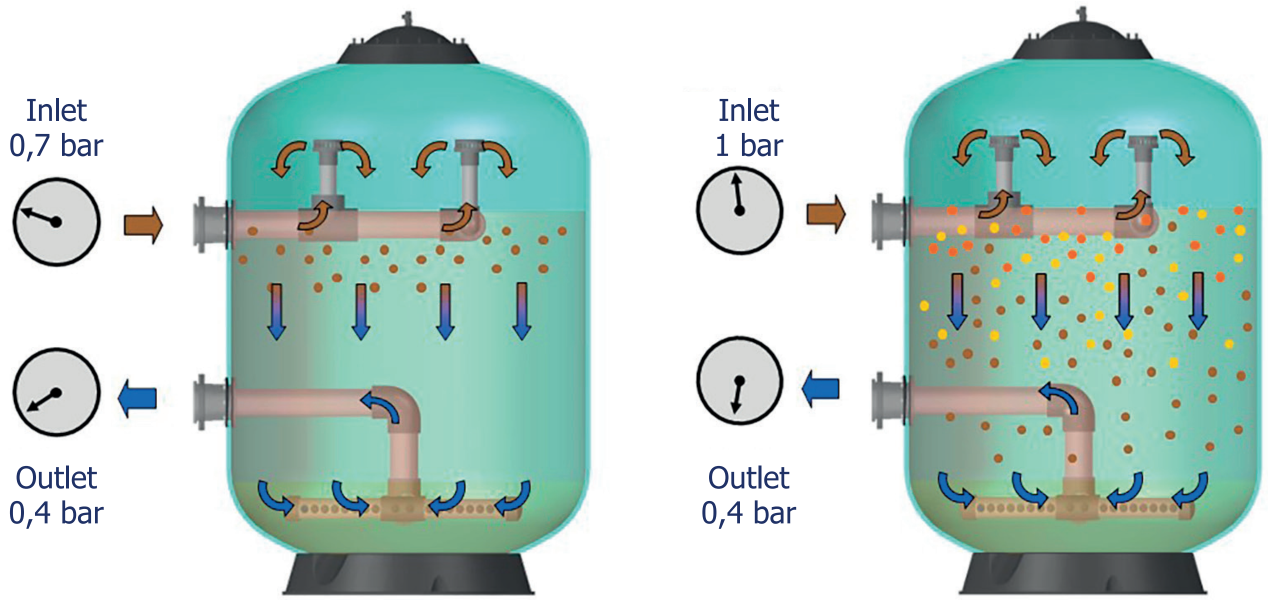


Image: How the filter media becomes dirty

- In so far as backwashing **times** are concerned, the first should be long, after having left the filter media to stand so that the dirt is transferred to the water without consuming water.

  It is recommended to start off with a 7-minute backwash with water and to observe whether the water comes out clean through the liquid sight glass on the drainage pipe. The decision can then be taken about whether the times should be lengthened or shortened.

- After backwashing, the filter media should be **rinsed**. This consists in setting the valves to the filtration position, but by making the water run out through the drainage pipe. The aim is to enable the filter media to settle and to drain away the dirty water inside the filter and the pipes.

  It is recommended to start off with 45 seconds and to then decide whether to change this time by looking through the liquid sight glass.

- The **amount of water** required for backwashing and rinsing can be calculated using the following equation:

  Water consumption for each backwash (m^3) =
  backwash flow rate (m^3/h) x backwashing time (min)/60 + rinsing flow rate (m^3/h) x rinsing time (seconds)/3,600

- The **rinsing flow rate** can be considered to be the same as the filtration flow rate.
- The **backwash flow rate** should be set based on the filter bed's technical specifications.
- As a general rule, the **recommended speeds** for backwashing flint sand or glass with water are between at least 40 m/h and 50 m/h at most.

An example of these operations:

Filtration and/or rinse speed: 30 m/h
Backwashing speed: 40 m/h
Diameter of filter: 1,600 mm, radius 0.8 m (1,600/2/1,000)
Filtration surface area: 0.8 x 0.8 x 3.14 = 2 m^2
Backwashing time: 7 minutes
Rinsing time: 45 seconds

Water consumption for each backwash

(m^3) = (40 x 2 x 7/60) + (30 x 2 x 45/3,600) = 10 m^3

- After backwashing, the **head loss** should be less than the previous head loss. The filtration-backwashing-rinsing process should thus become a repeated cycle.

  It is advisable to check the state of the filter bed if over time it becomes apparent that to keep the same maximum head loss the time between backwashes becomes shorter or if the initial head loss value is not recovered after a backwash.

- It is recommended to use devices such as **automatic valves**, programmed **controllers** and **pressure sensors** connected to the filter's inlet and outlet pipe to take pressure readings and perform a backwash when the desired setpoint is reached.

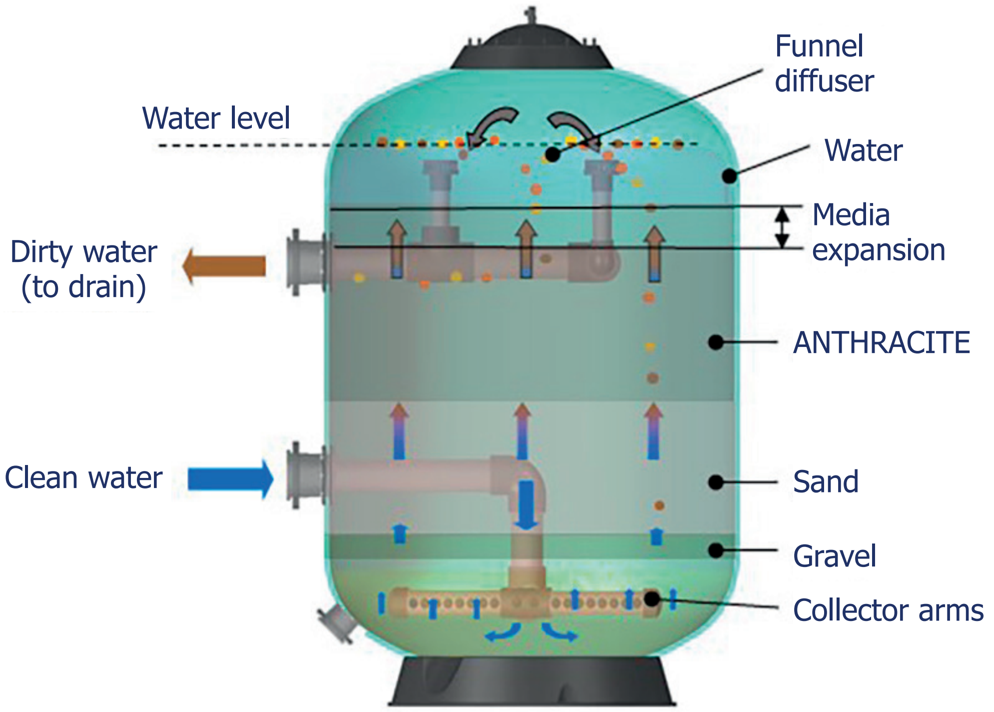


Image: Backwashing with water

Air scouring

Air scouring **reduces water consumption** and is able to clean the filter media **more efficiently**.

To do so, air is injected through a special connection at the bottom of the filter (or at the backwash water inlet). Thus, only electricity is consumed.

There are several ways of performing this operation:

- It can be started off with a short **backwash** with water. The water should then be drained off to below the level of the diffuser and the air injection process started. Later, a backwash should be performed to remove the dirt from the top of the filter. Finally, the filter media should be rinsed.
- It is also possible to start off with the **air injection** process, if the water level is below the diffuser.
- Another option is to **partially let water and air in** at any of the backwashing stages. In this case, the combined inflow of water and air must not overly increase the level of the fluidized filter media as it could surpass the level of the diffuser and be drained off.

In any case, some of the specifications for air scouring include:

- The **air flow** must be between 50 and 65 m/h.
- To reach this flow, a **blower pump** must be used with a top pressure of 0.5 bar. The flow can be adjusted by partially closing the valve and it must be ensured that the water level is always above the pump.
- Industrial air compressors, which supply an air pressure of 6 bar, should not be used.

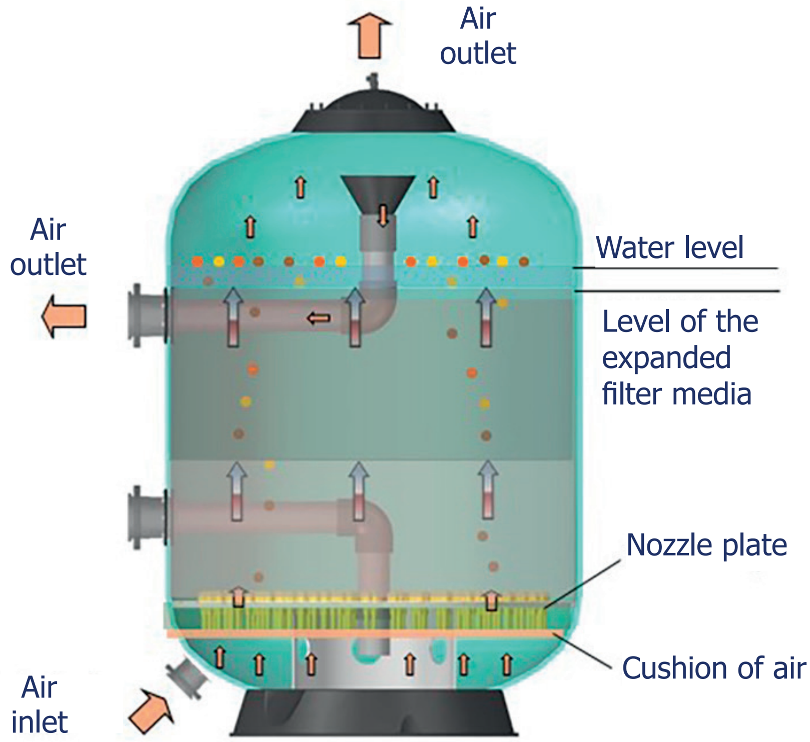


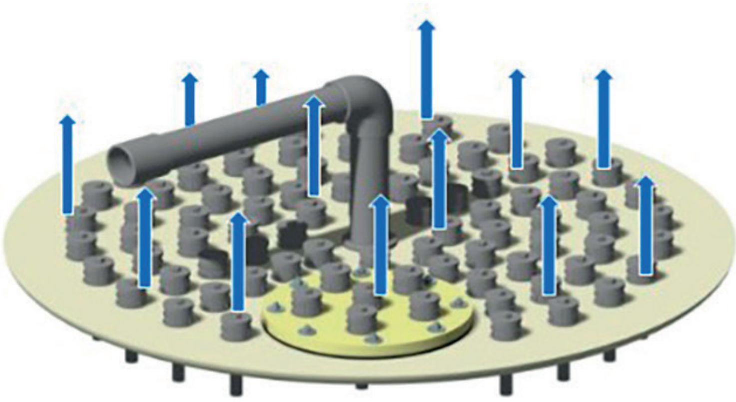
Image: Air scouring

- Before beginning to inject air, the water level in the filter must be **partially emptied** (halfway between the dirty water outlet diffuser and the level of the filter media). To do so, the valves must be set to the rinse position or the water drained off when the pump is not running.

  When the blower pump is working, the dirt (and the filter media) moves upwards to the water level, but it does not go down the drainage pipe.

- If the filter has been manufactured with a **nozzle plate**, the distribution of the air will be the same across the whole of the filter's surface. A cushion of air forms under the plate (a false bottom) that evenly distributes the air, thus preventing turbulence.

  If there are 0.5 mm slots, it is recommended that a side discharge outlet be added for the filter media.



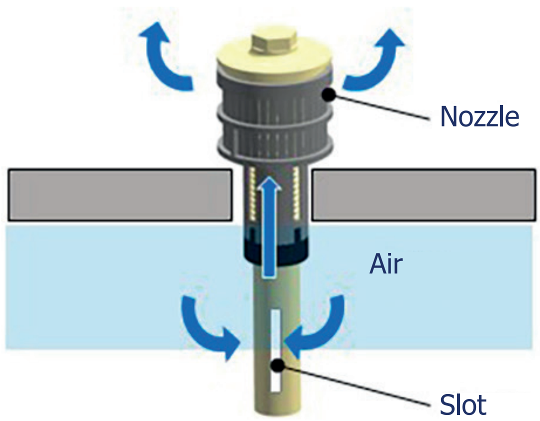


Image: Nozzle plate

Image: Filter with nozzle plate

Precautions to be taken during air scouring:

- If it is observed that the **level of the filter media** is above the diffuser, the air inlet should be partially closed.
- To prevent water from getting into a turbo blower pump, a **non-return valve** and a **siphon pipe** are recommended so that they are above water level.
- Ensure the filter's **top air relief valve** and the **dirty water outlet valve** are open throughout the backwashing process to prevent the filter from becoming pressurized.
- Open the air relief valve after backwashing until all of the air is released.

Good practices in installing and starting up the filtration system

- Follow the recommendations in the **instruction manual** at all times.
- Check that all components are in a **good state of repair** before loading the filter media and starting up the system.
- Make sure the filter is placed on a **hard, well leveled surface.**

- If there is the risk of a partial vacuum forming inside the filter, fit a **two-way pressure relief valve.**
- For the **start-up**, fill the filter halfway up with water and then add the filter media carefully so that the internal components are not damaged.

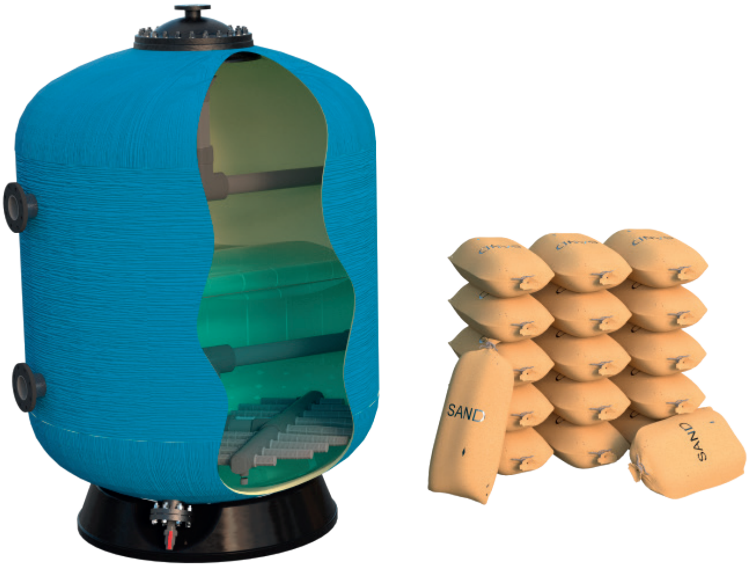
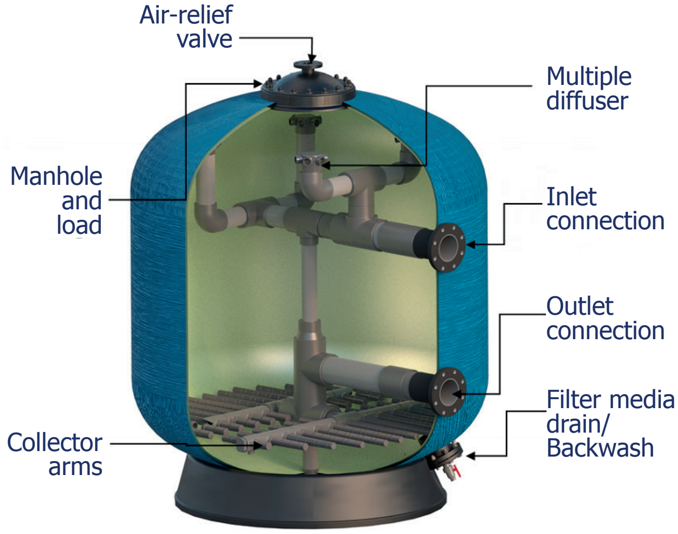


Image: Filter media

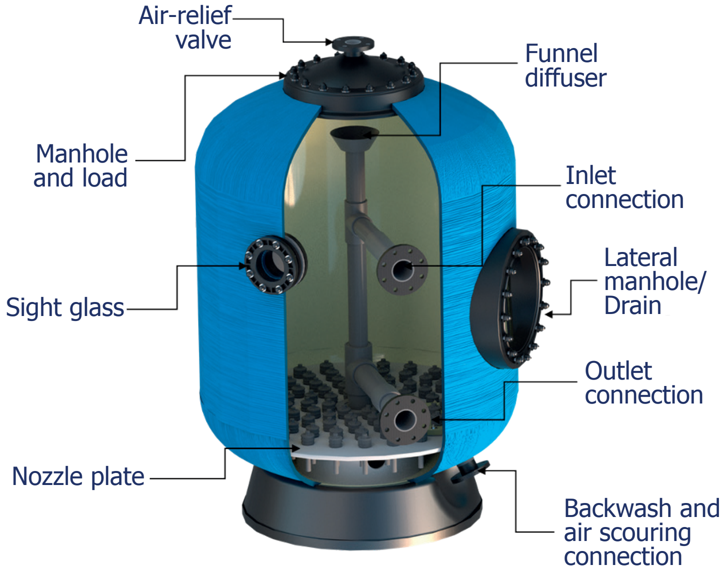
Image: Two-way pressure relief valve

Filter components

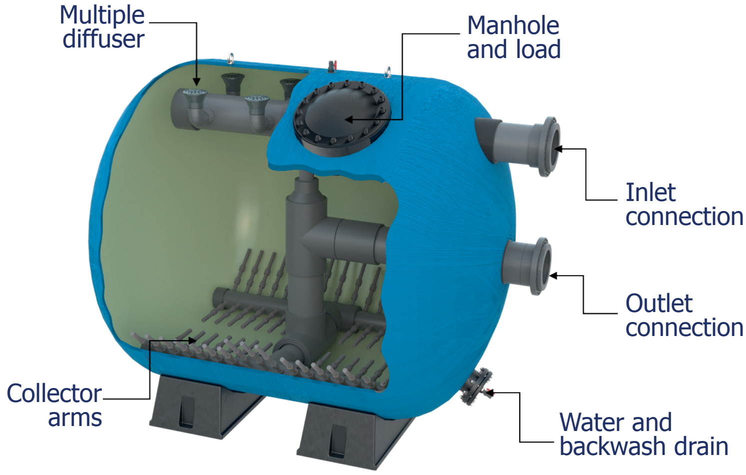
FILTER WITH COLLECTOR ARMS



FILTER NOZZLE PLATE



HORIZONTAL FILTER



04 OTHER ASPECTS FOR OPTIMAL FILTRATION

Smart systems

The most advanced filters detect when water needs to be cleaned in order to start up. This can make savings of up to 50% in water and electricity.

Accessories

Premium quality filters must come with efficient recirculation pumps (KIVU and Victoria, for example) and water disinfection systems such as a **Salt Chlorinator**, **Neolysis** o **Freepool2**.

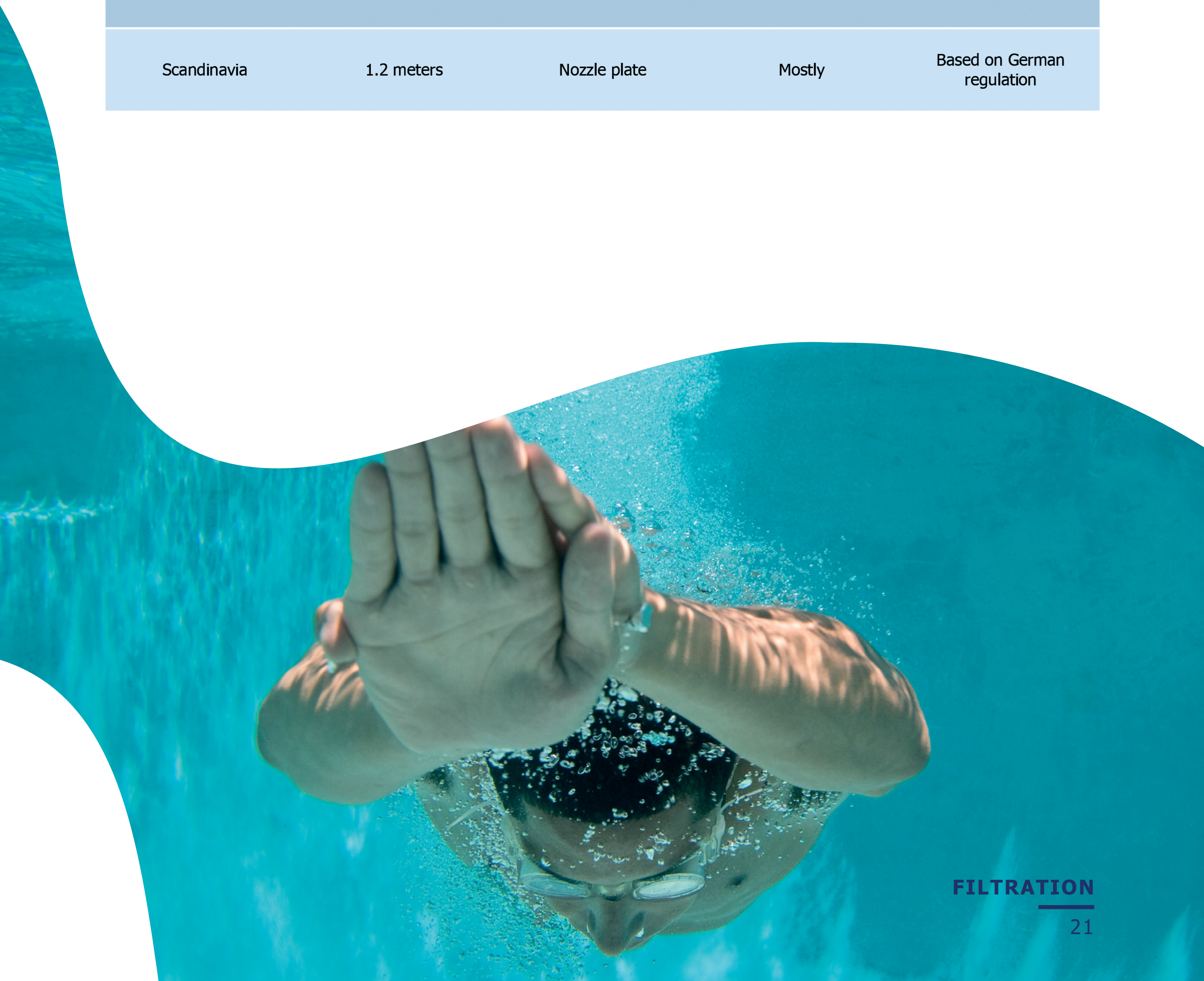
Filter maintenance

- **State of the filter bed:** ensure that the bed depth is right and that it expands as expected when backwashes are performed.
- **Air relief valve:** ensure that the air relief valve is working properly.
- **Head loss:** after backwashing, ensure that the initial pressure of the clean filter is recovered.
- **Environmental degradation:** ensure that UV rays are not degrading the filter and apply a coat of paint if necessary.
- **Filter watertightness:** ensure that there are no leaks or cracks, particularly at critical points such as the connections, lids, manholes and seals.
- **Changing the filter media:** whenever the filter media needs to be changed, also check the state of repair of the inside of the tank, pipes and, in particular, the collector system and nozzle plate, and replace them if crystallization or a change in color are observed.

Filtration standards for commercial pools

Some domestic laws must be complied with, which may also vary according to the specific location of each pool.

Region	Filter bed	Filter bed	Filter bed	Filter bed
Spain	1 meter	Collector arms	Rarely	According to autonomous community
France	1.2 meters	Nozzle plate	Recommended	Nationwide regulation
Italy	1 meter	Nozzle plate	Recommended	UNI standard based on DIN standard
Germany	1.2 meters	Nozzle plate	Required	DIN 19605 DIN 19643
Scandinavia	1.2 meters	Nozzle plate	Mostly	Based on German regulation



05 ASTRALPOOL FILTER MODELS FOR COMMERCIAL POOLS

AstralPool's range of filters for commercial pools are divided into two categories depending on their **finish**: bobbin-wound or laminated. There are also different models of valve manifolds.

Laminated filters

Vesubio

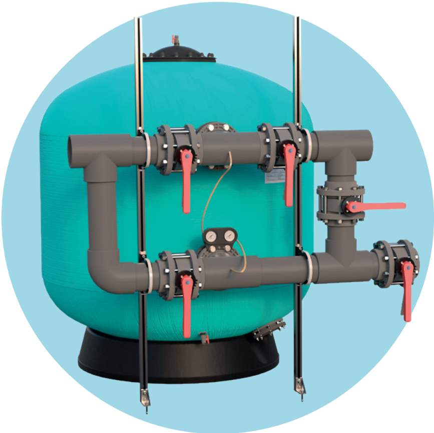
- Made of polyester resin and fiberglass.
- Equipped with a pressure gauge, and manual water and air purge valves.
- Ø 400mm top lid.
- Suitable for filtration speeds of 20, 30, 40 and 50 $m^3/h/m^2$.
- All filters can be assembled with valve manifolds.
- $2^{1/2}$" sand discharge outlet.
- Collector arms.

Europe

- Made of polyester resin and fiberglass.
- Equipped with a pressure gauge, and manual water and air purge valves.
- Ø 400mm top lid.
- Suitable for filtration speeds of 20, 30, 40 and 50 $m^3/h/m^2$.
- All filters can be assembled with valve manifolds.
- Optional collector arms and nozzle plate.

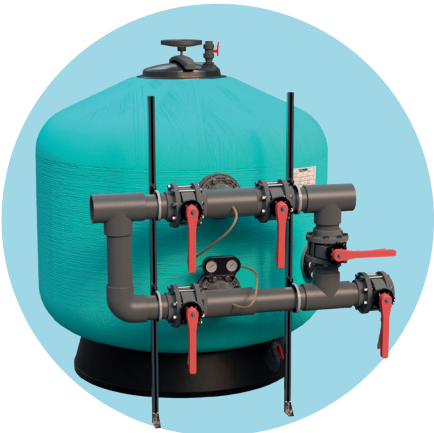
Bobbin wound filters

Praga



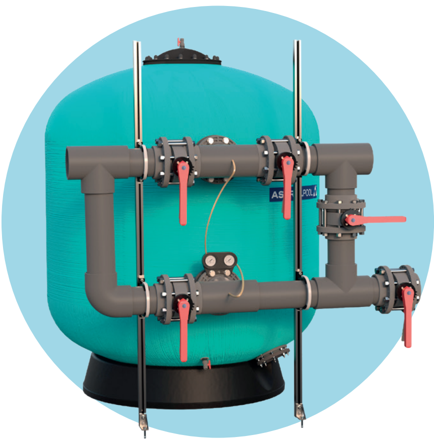
- Bobbin-wound filters made of polyester resin and fiberglass.
- Equipped with pressure gauge, and manual air and water purge valves.
- Ø 400mm top lid.
- Suitable for filtration speeds of 20, 30, 40 and 50 $m^3/h/m^2$.
- All filters can be assembled with valve manifolds.
- $2^{1/2}$" sand discharge outlet.
- Optional collector arms and nozzle plate.

Vic



- Bobbin-wound filters made of polyester resin and fiberglass.
- Equipped with pressure gauge, and manual air and water purge valves.
- 400 × 500 mm Quik top lid.
- Suitable for filtration speeds of 20, 30, 40 and 50 $m^3/h/m^2$.
- All filters can be assembled with valve manifolds.
- 75 mm lateral sand drain.
- Optional collector arms and nozzle plate.

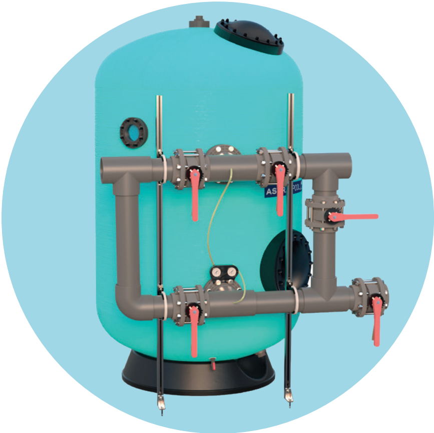
Oslo



BED DEPTH FILTER: 1,2 m

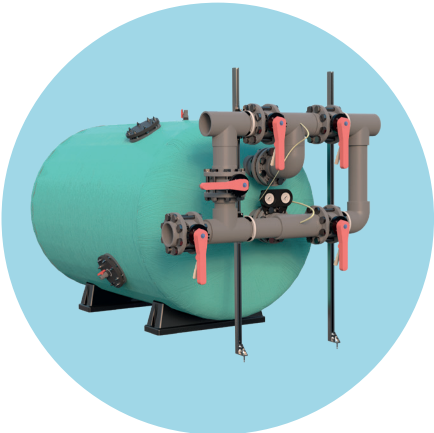
- Bobbin-wound filters made of polyester resin and fiberglass.
- Equipped with pressure gauge, and manual air and water purge valves.
- Ø 400mm top lid cover.
- Suitable for filtration speeds of 20, 30, 40 and 50 $m^3/h/m^2$.
- All filters can be assembled with valve manifolds.
- $2^{1/2}$" sand discharge outlet.
- Optional collector arms and nozzle plate.

Olot



- Designed following the guidelines of the standards DIN 19605/19643.
- Bobbin-wound filters made of polyester resin and fiberglass.
- Equipped with pressure gauge, and water purge valves.
- Ø 400 mm top lid and Ø 400 mm lateral manhole included.
- All filters can be assembled with valve manifolds.
- Nozzle plate included.

Rodas



HORIZONTAL FILTERS

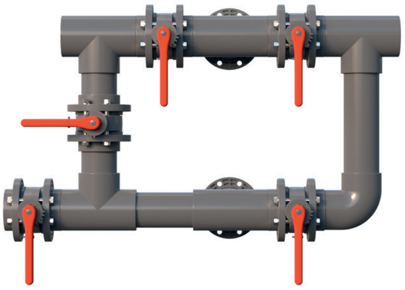
- Bobbin-wound filters made of polyester resin and fiberglass.
- Equipped with pressure gauge, and air and water purge valves.
- Ø 140 mm or Ø 400 top lid according to model.
- Ø 400 mm side lid according to model.
- Ø 140 sand discharge.
- All filters can be assembled with valve manifolds.

Berlín

- Bobbin-wound filters made of polyester resin and fiberglass.
- Equipped with pressure gauge, and manual air and water purge valves.
- Ø 400mm top lid cover.
- Suitable for filtration speeds of 20, 30, 40 and 50 $m^3/h/m^2$.
- All filters can be assembled with valve manifolds.
- Collector arms.

Types of valve manifolds

Manual Manifold. 5 Butterfly Valves



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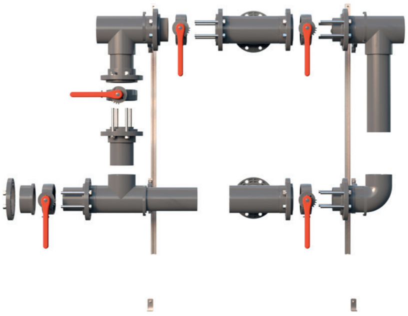
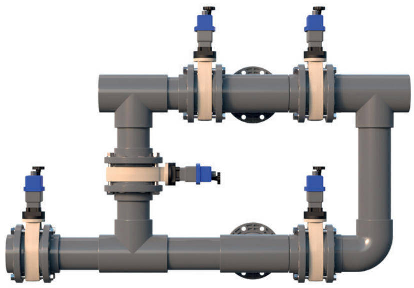


- Butterfly valve.
- Regulable opening every 15º with position holding
- One piece body in PVC-U
- Fixed in the set with galvanized steel screws
- Standard DIN 2501 flanges

Electric Manifold. 5 Butterfly Valves



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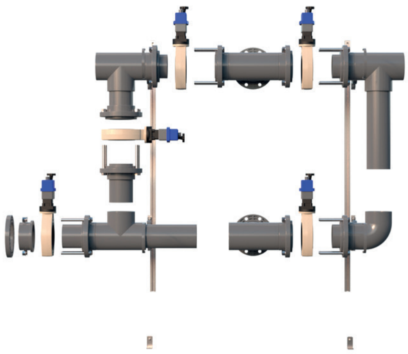
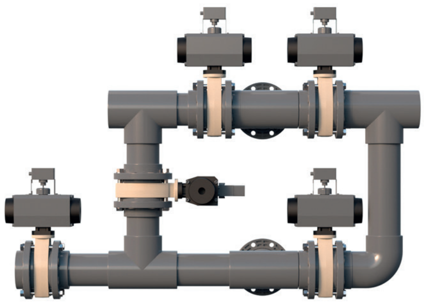


- Butterfly valve with electric J+J actuator of 80-240 V
- Electronic torque control, with limitation of maximum torque
- Anti-condensation heating resistor
- Automatic/manual lever, with manual override
- Open and closed volt free contacts
- LED operating/error indicator
- Enclosure in anticorrosive polyamide
- Standard DIN 2501 flanges
- Fixed in the set with galvanized steel screws

Pneumatic Manifold. 5 Butterfly Valves



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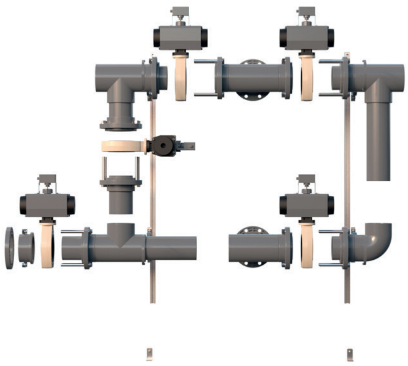


- Butterfly valve with pneumatic actuator CH-air with limit switch box
- Rack and pinion drive
- Valve position visualization
- NAMUR connection that allows the assembly of the solenoid valve
- Final position regulation in the actuator (+/-5º)
- Fixed in the set with galvanized steel screws
- Standard DIN 2501 flanges

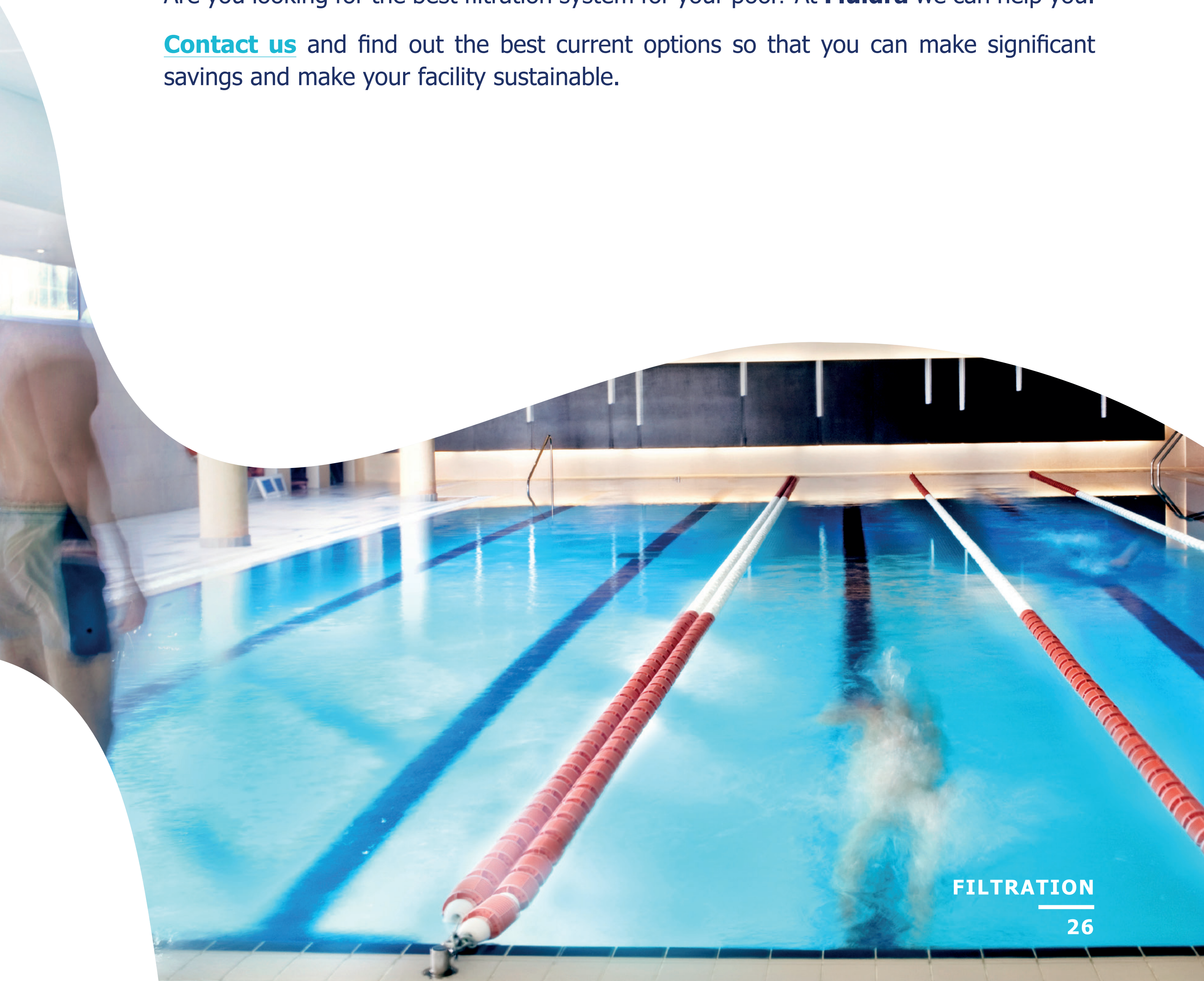
06 CONCLUSIONS: DESIGN AND TECHNOLOGY FOR OPTIMAL FILTRATION

The choice of a **suitable filtration system** can make a difference in the financial and environmental costs of water facilities.

Given current technological advances, it is advisable that the builders seek the **advice of an experienced expert** who is also able to **customize the system proposed** to the requirements of each project.

Are you looking for the best filtration system for your pool? At **Fluidra** we can help you.

Contact us and find out the best current options so that you can make significant savings and make your facility sustainable.



07 REFERENCES

- Water Treatment Handbook, Degrémont
- Saunus, Swimming Pools.
- DIN 1605, DIN 19643

"This information contains general recommendations that must be taken into consideration on a case-by-case basis. This information is not an instruction manual and cannot be considered as such for any purpose. Any implementation or installation to be made must be made by a professional and under the appropriate guidelines. In this regard, each user is responsible for the application it makes of the information contained herein. Fluidra will not be responsible for its use. Consequently, under no circumstances will Fluidra be liable or responsible for any claim, damages or loss that may arise as a consequence of the use of this information".

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