GreenTube - HighPure

The IPC Pure Water Cleaning Systems

Integrated Professional Cleaning

IPC

Product presentation guidelines

Market opportunities and main users

There are ever more uses for cleaning systems based on pure, osmotic and demineralised, water (glazing, solar and photovoltaic panels, boats, aeroplanes, interiors, etc.).

Market opportunities and main users

Main users

- Companies (self cleaning).
- Cleaning contractors and window cleaners.
- Solar panel installers/maintainers.

Principali canali distributivi

- Distributors specialized on window cleaning equipment.
- Distributors of cleaning machine and equipment.

Main applications

- Buildings up to 5 stories where ladders, lifts or scaffolding is needed to clean windows.
- Green houses.
- Cleaning of solar and photovoltaic panels.

Window cleaning through pure water

How it works

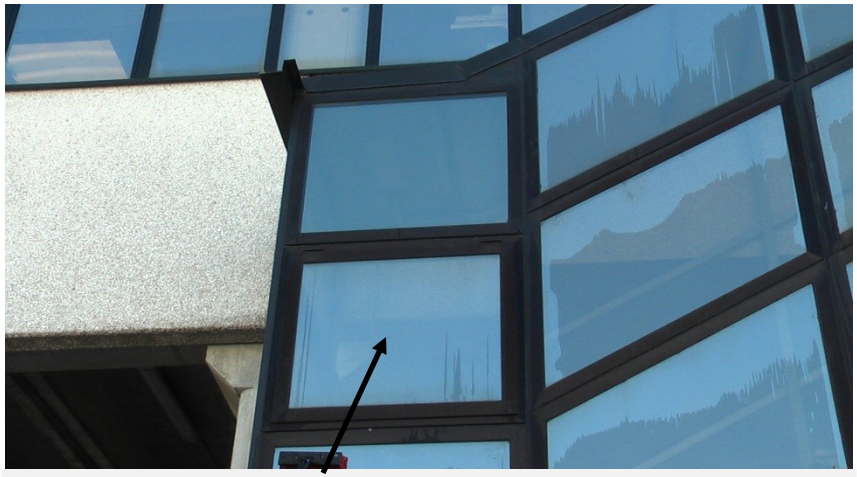
1. Water inlet hose.
2. Power supply: electric motor or battery.
3. Water purification system (HighPure).
4. Water feed hose.
5. Operators work safely on the ground.
6. Water fed pole.
7. Water fed brush and gooseneck.

How the IPC HighPure systems works:

- HighPure system produces pure water.
- Pure water is carried upper-level through a pole and is applied by a brush.
- The combined use of pure water and brush removes dirt from glass and frames.
- Pure water removes dirt and holds it in suspension.
- The glass is rinsed and impurities are removed. The pure water dries naturally, without leaving salt deposits in suspension and the glass is clear and immediately free.

GreenTube & HighPure – working phases

1. Washing



2. Natural drying

3. Final result

GreenTube & HighPure – the result

BEFORE

AFTER

HighPure – system and advantages

HighPure is the cleaning system for windows and in general for all non-porous surfaces that uses 100% pure water, through an integrated system of poles in glass and carbon fibre and brushes, that allows to reach easily surfaces up to 15 meters height.

- **High productivity:** HighPure slashes window cleaning times by up to 75% compared to conventional methods, generating a fast return of investment (ROI)

- **Safety**: elimination of risks, the operator works from the ground and without using ladders or scaffolding.

- **Environmentally friendly**: totally ecological, thanks to the elimination of all potentially pollutant chemical products. The waste water can be disposed of into the public drains.

- **Effective**: windows are perfectly rinsed and remain crystal clear for longer since no chemical or salt residues are left behind.

- **Practical and easy to use**: the completed suite of poles and brushes allows to use HighPure from the ground and to reach easily corners or inlets for their cleaning.

Machines and accessories

The machines: GreenTube GT0 – GTE

Professional use, light duty (up to 1-2 hours/day)

GreenTube GT0

- Without pump
- Pure water flow rate and pressure depend on the water supply
- One pole operation

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GreenTube GTE

- Rotative vane pump powered by electric motor 220 V – 0,25 kW (single phase)
- Pure water flow rate 2-4 l/min
- Pure water pressure up to 5 bar
- One poles operation

The machines: HighPure HP0 – HPB – HPE

Professional use, heavy duty (until 8 hours/day)

HighPure HP0

- Without pump
- Pure water flow rate and pressure depend on the water supply
- One pole operation

HighPure HPE

- Rotative vane pump powered by electric motor 220 V – 0,37 kW (single phase)
- Pure water flow rate 2-6 l/min
- Pure water pressure 6-7 bar
- Two poles operation

HighPure HPB

- Membrane pump powered by battery
- Gel battery 12 V - 33 Ah
- Pure water flow rate 2-5 l/min
- Pure water pressure 4-5 bar
- One pole operation

The machines: HighPure HPG

Professional use, heavy duty (until 8 hours/day)

NEW!

HighPure HPG

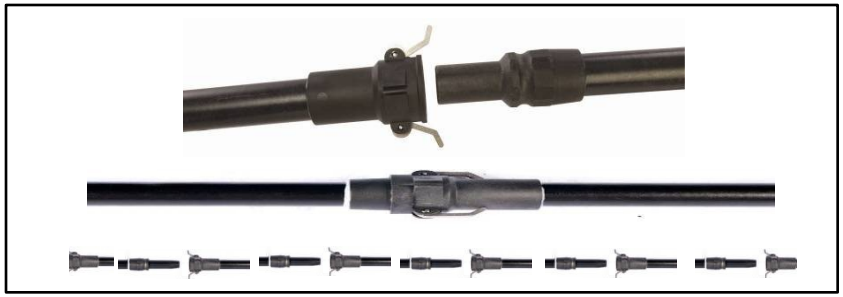
- Rotative vane pump powered by endothermic motor Honda GX 120 (4 HP), 5 hours working time/tank
- Pure water flow rate 3 - 7 l/min
- Pure water pressure 7 - 8 bar
- Two poles operation

Sectional and telescopic poles range

6 m glass fibre telescopic pole with 5 cm adjustable plastic gooseneck and 28 cm nylon brush

10,5 m fusion (glass fibre + carbon fibre) telescopic pole with 5 cm adjustable plastic gooseneck and 28 cm nylon brush

13 m carbon fibre telescopic pole with 25 cm adjustable plastic gooseneck and 36 cm nylon brush



Carbon fibre sectional poles kit (Quick lock): 10 m and 16 m kit

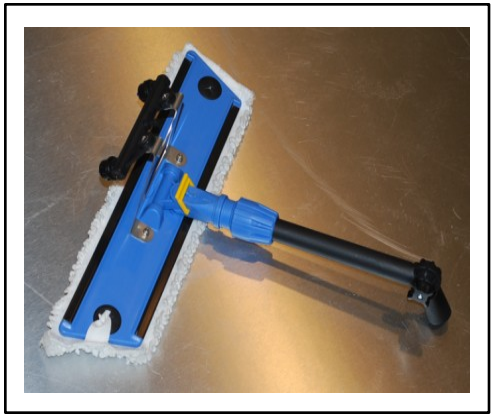
The brushes

Speed Brush

- Designed to glide on glass with less fatigue allowing you to clean longer, be more productive, clean faster all while still getting the great performance you expect
- Specifically engineered soft synthetic bristles “flare out” (35 cm and 45 cm width) to glide on the window ensuring all corners and edges are cleaned without damaging window frames
- Flared bristles prevent brush block hitting the frame and reducing noise for building occupants
- Utilizes more surface area of the bristles to reduce brush strokes compared to brushes which clean only with the tips of their bristles
- Designed to hold water between brush and glass for better cleaning without the water deflection of other brushes and allowing for prolonged use of the water
- Also available in natural bristles of 35 cm width for more water retention and a more aggressive scrub
- Available in single zero degree or with both dual spray zero degree and fan nozzles:
    - Zero degree is preferred by many because it allows for controlled rinsing within the frames
    - Fan nozzles utilize a unique angle spray that allows for getter rinsing of hydrophobic windows but with much improved control for rinsing

The brushes

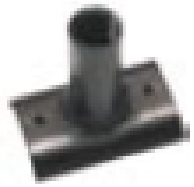
Brushes with stiff nylon bristles of 28 cm and 36 cm suitable on heavy dirt (provided in standard equipment with telescopic poles, please see the price list)



Microfiber mop kit: frame with pure water spray nozzle, adjustable gooseneck and loop microfiber mop. Suitable both for window and photovoltaic cleaning

The goosenecks

Plastic adjustable goosenecks available in 5 cm e 25 cm (provided in standard equipment with telescopic poles, please see the price list)



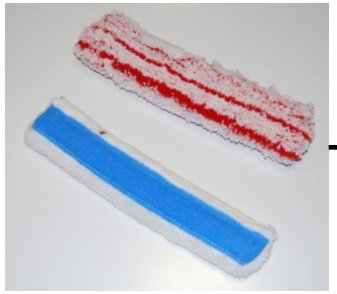
Gooseneck adaptor: allow the connection of the plastic adjustable gooseneks with the Speed Brushes

Aluminum adjustable goosenecks available in 10 cm, 20 cm and 40 cm

Special accessories

Double brush adaptor

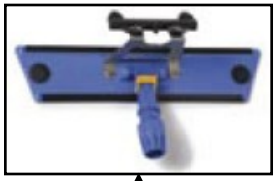
- Enables operator to use 2 Speed Brushes side by side at the same time, cutting cleaning time in half
- Can be used with synthetic or natural bristle Speed Brushes
- Available in 3 different sizes of goosenecks, 10 cm, 20 cm and 40 cm all adjustable aluminum goosenecks
- Suitable both for big window surfaces and photovoltaic cleaning



Back Scrub

- Useful on the prevent removal of heavy dirt
- Directly mounted on the aluminum adjustable goosenecks
- Usable with different kind of washer sleeves
- Easy to use and control at different heights

Poles and accessories: possible configurations



Sectional poles

Telescopic poles

N.B. The telescopic poles are provided with gooseneck and brush in standard equipment

Machines principle operation and cleaning action of the pure water

4 filtration stages system

How HighPure works

Hard Water

Measured in part per million (ppm)

Removes dissolved substances (salts, impurities, etc) bigger than 5 µm

Sediment filter

Carbon filter

Removes chlorine (Chlorine degrades RO membrane)

Removes up to 95%-98% of the dissolved substances (salts, impuruties, etc.)

RO Membrane

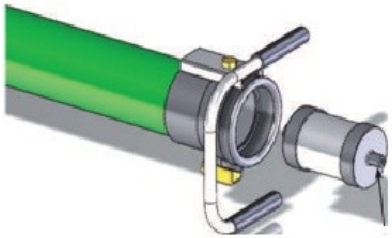
DI Resin Cartridge

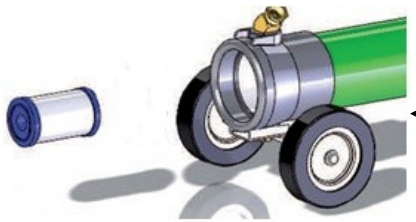
Removes the balance of the dissolved substances

100% Pure Water

4 filtration stages system

How GreenTube works





100% Pure Water

Di Resin Cartridge

RO Membrane

Carbon filter

Sediment filter

Hard Water

Measured in part per million (ppm)

Water hardness

The **water hardness** value expresses the calcium and magnesium ion content (coming from the soluble salts in the water) and the amount of possible heavy metals present in the water.

The salts determining hardness are usually present in the water in the form of sulphates, chlorides, nitrates, carbonates or hydrogencarbonates. They are generally soluble, but precipitate through heating or evaporation to form limescale or other encrustations.

Hard water has a negative effect on washing processes. On one hand the constituent molecules combine with the calcium ions to form insoluble compounds which increase the quantity of detergent necessary for cleaning. On the other, the presence of encrustation forming substances damages the surfaces treated due both to their corrosive action and the encrustations themselves. This is why use is often made of "softening" techniques, namely the removal of calcium and magnesium salts.

Hardness is generally expressed in French degrees (°f), where one degree corresponds to 10 mg of calcium carbonate ($CaCO_3$) per litre of water (1 °f = 10 mg/l = 10 ppm - parts per million).

In general, water is classified according to hardness as follows:

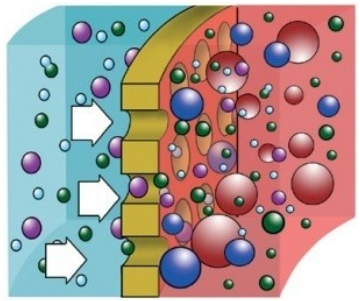
- up to 7 °f (70 ppm): very soft
- from 7 °f to 14 °f (70 – 140 ppm): soft
- from 14 °f to 22 °f (140 – 220 ppm): moderately hard
- from 22 °f to 32 °f (220 – 320 ppm): slightly hard
- from 32 °f to 54 °f (320 – 540 ppm): hard
- more than 54 °f (540 ppm): very hard

Reverse osmosis

Pure or demineralised water is water with the salt component removed.
Pure water can be obtained through ion exchange using anionic or cationic resins. These resins must be regenerated with acid and caustic substances.
To reduce regeneration costs, before demineralisation, the water is pre-treated by reverse osmosis which reduces the salt content by more than 90%.

Osmosis

The term osmosis describes the diffusion of a solvent through a semipermeable membrane from the area with the highest water potential (lowest concentration of solute) towards the area with the lowest water potential (highest concentration of solute), thus in the opposite direction to the concentration gradient.
Osmosis is a spontaneous process which tends to dilute the most concentrated solution, thus reducing the difference in concentration.



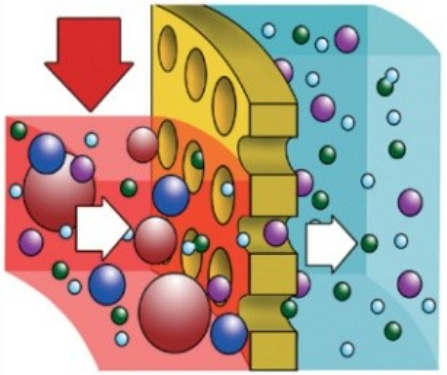
Osmotic pressure

Every solution has an osmotic pressure which is directly proportional to its molarity. When the solutions on either side of a membrane have different concentrations, the difference in osmotic pressure moves the solvent molecules from the least concentrated solution (hypotonic) towards the most concentrated solution (hypertonic), until the concentrations of the two solutions are identical (isotonic) and the two chemical potentials are the same.

Reverse osmosis

Reverse osmosis

Reverse Osmosis (**RO**) is the process by which the solvent molecules are forced to pass through a semipermeable membrane from the most concentrated solution to the least concentrated solution through application of a pressure greater than the osmotic pressure to the most concentrated solution. Reverse osmosis uses a membrane known as an **osmotic membrane** which retains the solute on one side, preventing it from passing and allowing the pure solvent to be obtained on the other side. This phenomenon is not spontaneous and requires a mechanical action equal to that required to cancel out the effect of osmotic pressure.

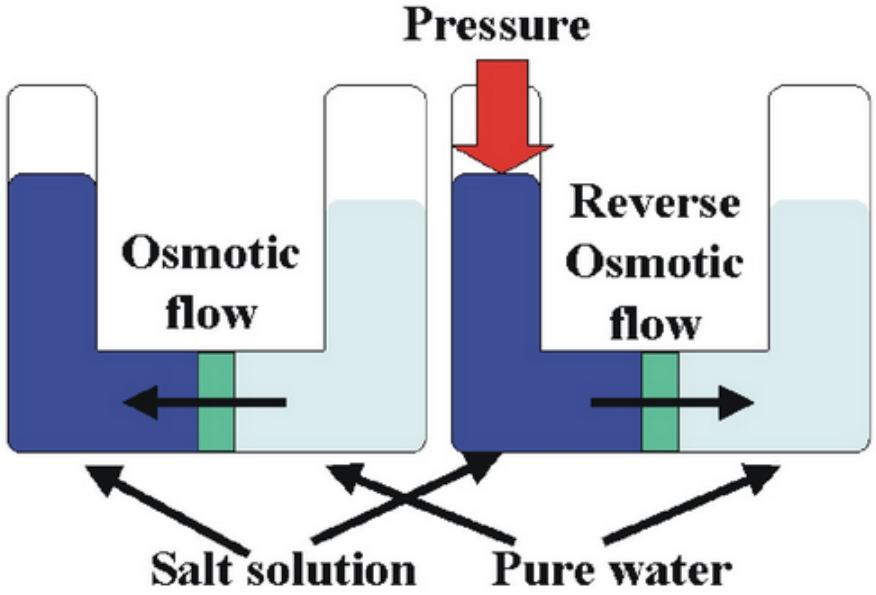


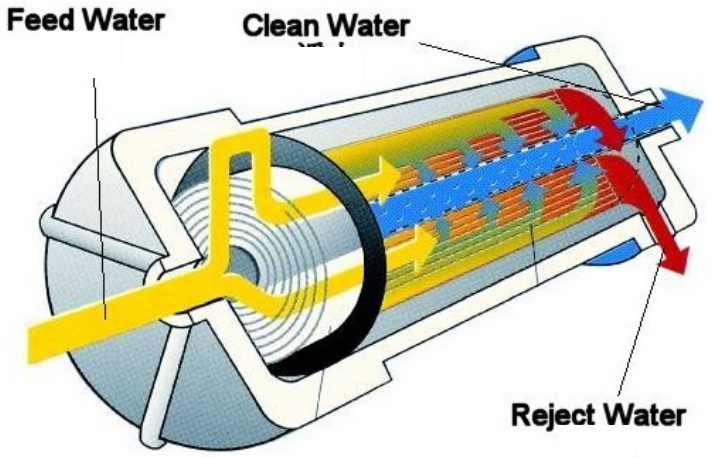
Reverse osmosis is the most reliable, most widespread system in the world. It is also the most refined water filtration technique as it not just involves a physical obstacle (determined by the size of the pores) to passage of the molecules, but also exploits the different chemical affinity of the compounds with the membrane, allowing the passage of hydrophilic "water-loving" molecules (in other words, those most chemically similar to water) and preventing the passage of others with less affinity. This allows **water with a purity of up to 95-98 %** to be obtained. Reverse osmosis is used to treat water for desalination and to remove traces of phosphates, calcium and heavy metals, as well as pesticides, radioactive material and almost all pollutant molecules.

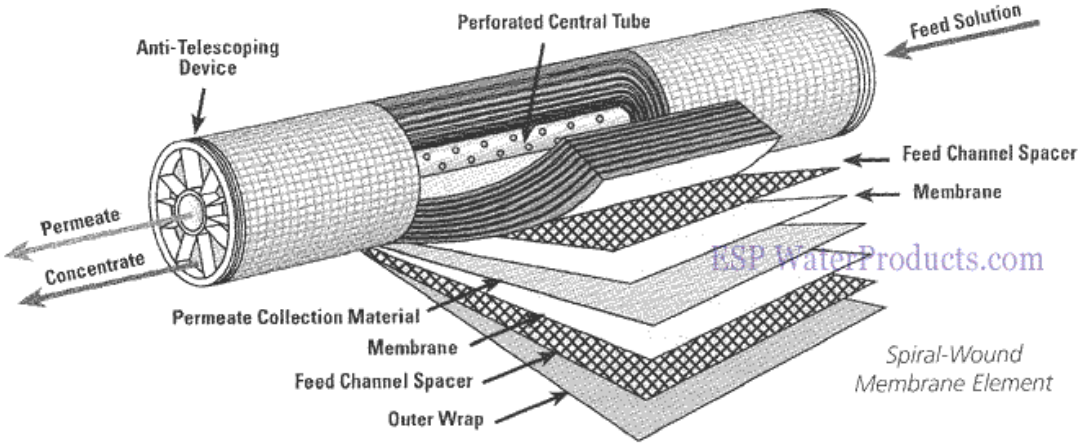
Reverse osmosis

Osmotic membranes, the heart of all osmosis systems, are made up of layers of thin semipermeable film (TFC or TFM, *Thin Film Composite Membrane*). A TFC is a molecular sieve consisting of a film of two or more stratified materials.

Generally the membranes used in osmosis are made from polyamide, chosen mainly for its permeability to water and relative impermeability to the various dissolved impurities, including salt ions and other small molecules which cannot be filtered.







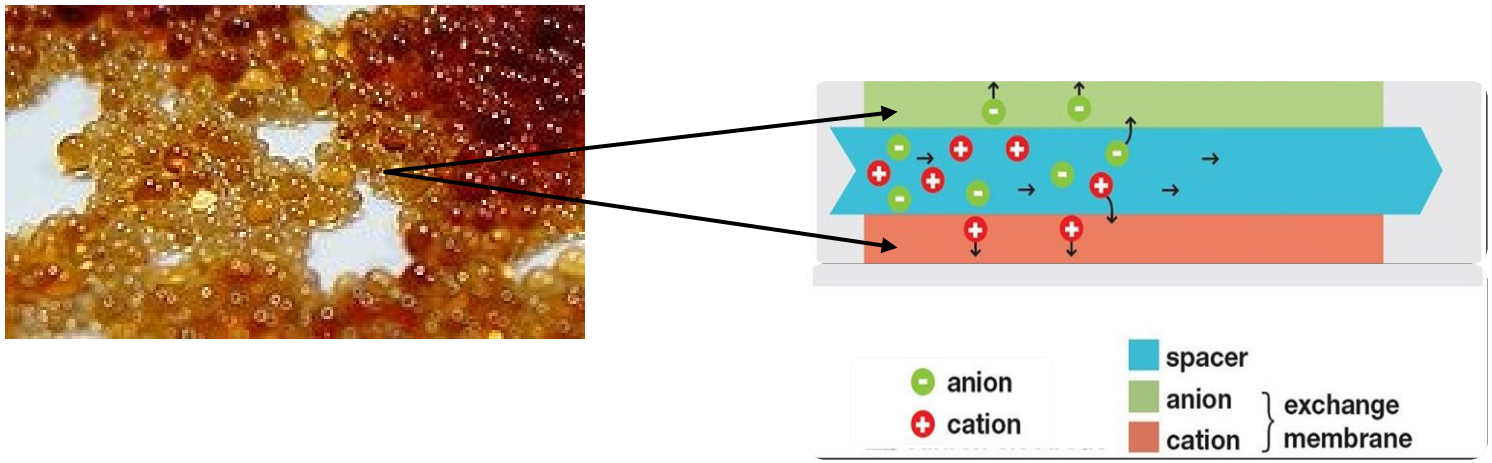
Deionising with ion-exchange resins

Deionising is another process used to obtain pure water.

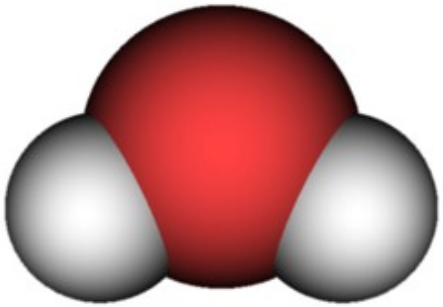
This process involves specifically developed ion-exchange resins which remove impurities from the water passed through them to obtain extremely pure water. During the process, the ions of a given chemical compound on the surface of an insoluble exchange material (ion-exchange resin) are replaced by ions of a different chemical compound dissolved in the solution.

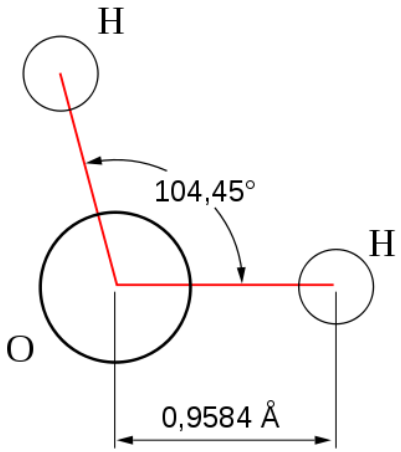
An **ion-exchange resin** consists of a polymer matrix (usually granules with a diameter of just a few millimetres) in which the ions available for the ion exchange are trapped or incorporated. There are numerous ion-exchange resins, generally polystyrene based and reticulated with divinylbenzene, to which the functional groups to capture or release the ions are added.

The resins can be cationic (able to exchange cations) or anionic (able to exchange anions). The water deionising process uses mixed resin beds, in other words, containing a mix of both cationic and anionic resins.



How pure water acts on dirt





Water is a chemical compound with the molecular formula H_2O, in which two hydrogen atoms are bonded to an oxygen atom**.**

Chemically speaking, water is an excellent solvent. Natural water contains numerous dissolved substances and this is why the term water is usually used to described both the pure chemical with the formula H_2O, and the mixture (liquid) formed by this with the other substances dissolved in it.

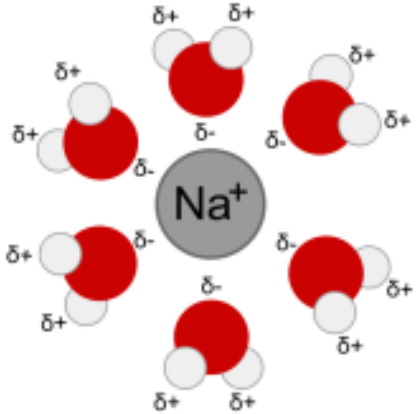
The **behaviour of water as a solvent** is determined by the polarity of the molecules. The water molecule forms an angle of 104.45° with the oxygen atom at the vertex and the two hydrogen atoms at the two ends. Given that oxygen has a greater electronegativity, the vertex of the molecule has a partial negative charge ($\boldsymbol{\delta^-}$), while the ends have a partial positive charge ($\boldsymbol{\delta^+}$). A molecule with this unbalance of electrical charges is said to have an **electric dipole.**

How pure water acts on dirt

When an ionic or polar compound is dissolved in water, it is surrounded by the water molecules. Their small size enables them to penetrate between one ion (or one molecule) and another of the solute, oriented so that each ion (or polar extremity) of the solute corresponds to the part of the water molecule with the opposite charge. This weakens the attraction between the ions (or polar molecules) and breaks the crystalline structure. Each ion (or polar molecule) is thus solvated (or hydrated), in other words, completely surrounded by water molecules which interact with it.

Common cooking salt (sodium chloride) is an ionic solute.

Sugar is a polar solute.



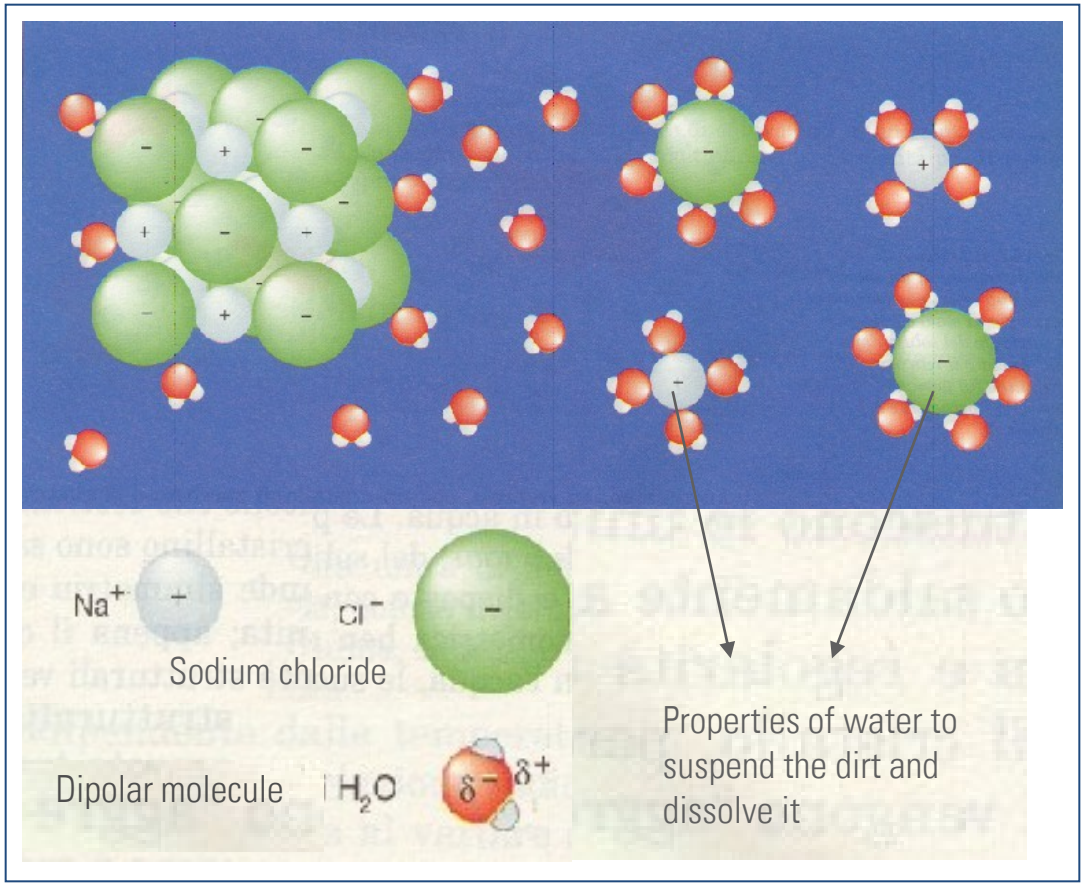
In general, polar ionic substances (such as acids, alcohols and salts) are fairly soluble in water, while non-polar substances (such as fats and oils) are not. Non-polar molecules do not mix with the water as, in the case of water, in terms of energy, the formation of internal hydrogen bonds is preferred to the formation of Van der Waals bonds with non-polar molecules.

Pure Water: cleaning action on the dirt

The quality of the water determines the quality of the cleaning. The purer the water, the more efficient its cleaning power.

Pure Water, because its definition free of dirts and impurities, result less saturated than the "normal" water (not pure), then with a greater attractive potential on the positive and negative charges. It is therefore able to dissolve a larger quantities of substances and then more aggressive against the dirt.

Pure Water, used on the rinsing, leaves the surfaces completely cleaned and without streaks and smears.

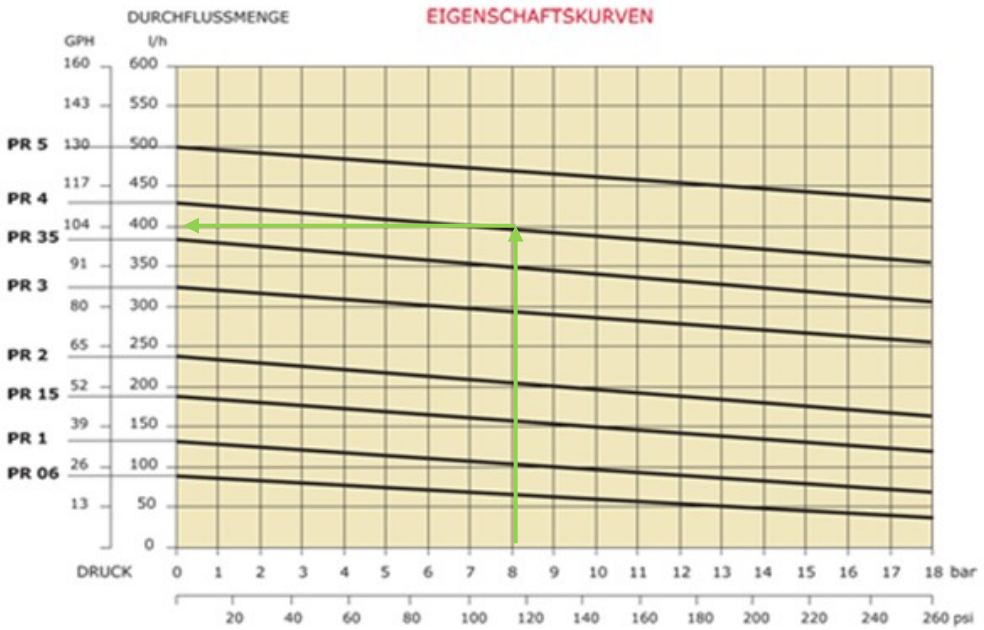


Technical details

Motor-pumps technical specification

GreenTube GTE

- NU.ER.T rotative vane pump mod. PR4
- Electric motor 230 V, 50 Hz AC, 0,25 kW



Pumpencode

Serie PR	DURCHFLUSSMENGE (L/Std) a 1400 U/min.			
	0 bar	5 bar	9 bar	14 bar
PR 06	90	78	63	55
PR 1	125	115	110	85
PR 15	175	160	150	135
PR 2	230	220	205	185
PR 3	320	310	295	280
PR 35	370	355	340	330
PR 4	420	405	390	380
PR 5	500	490	475	458

Indikative Durchfluss-Mengen, bezogen auf:
Pumpen ohne Bypass, Motor mit andauernder Geschwindigkeit a 1400 U/min, Wasser a 20° C (68° F)

Motor-pumps technical specification

HighPure HPB

- SHURflo membrane pump
- Gel battery 12 V - 33 Ah

SHURflo
First in Fluid Innovation

8000 Series Diaphragm Pump
High Pressure Demand Pump
(12 VDC)

Model	8002-793-238			
Description	1.7 GPM open flow, EPDM valves, Santoprene® diaphragm, 100 PSI Demand Switch, 3/8" NPT-Female ports, Nylon Housing			
Voltage	12 VDC			
PSI	20	40	60	100
BAR	1.4	2.8	4.1	6.9
GPM	1.61	1.45	1.35	1.15
L/min	6.1	5.5	5.1	4.3
Amps	4.4	5.7	7.0	9.3

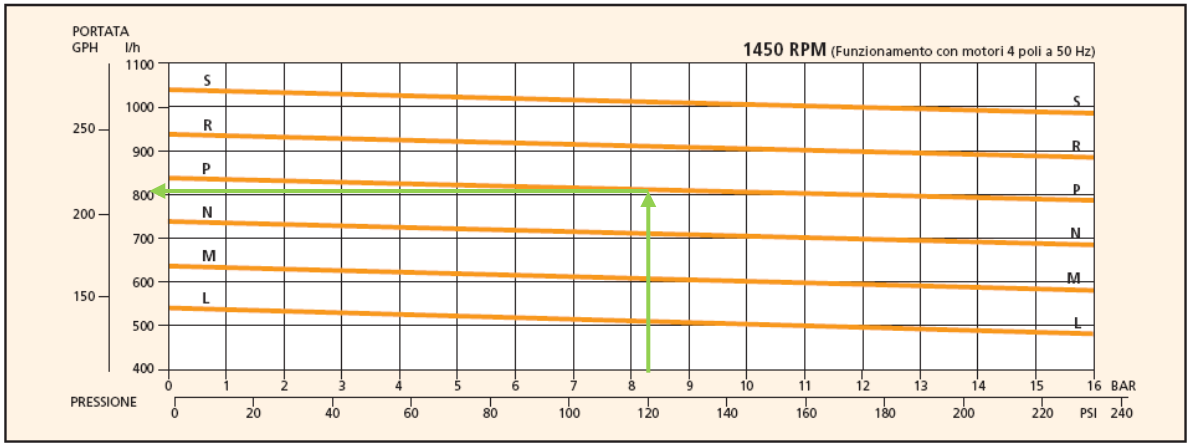
HighPure HPE

- Fluid-o-Tech rotative vane pump
- LEESEN electric motor mod. C4C17FB45A
230 V, 50 Hz AC, 0,37 kW

MODELLO PO/PA Ottone	500	501	500F	501F	600	601	600F	601F	700	701	700F	701F	800	801	800F	801F	900	901	900F	901F	1000	1001	1000F	1001F
MODELLO PO/PA Acciaio Inossidabile	510	511	510F	511F	610	611	610F	611F	710	711	710F	711F	810	811	810F	811F	910	911	910F	911F	1010	1011	1010F	1011F
l/h a 2 bar		540				640				740				840				940				1040		
l/h a 7 bar		520				620				720				820				920				1020		
l/h a 14 bar		497				597				697				797				897				997		
Curve		L-L				M-M				N-N				P-P				R-R				S-S		
Valvola By-Pass	NO	SÌ	NO	SÌ	NO	SÌ	NO	SÌ	NO	SÌ	NO	SÌ	NO	SÌ	NO	SÌ	NO	SÌ	NO	SÌ	NO	SÌ	NO	SÌ
Montaggio flangia	NO	NO	SÌ	SÌ	NO	NO	SÌ	SÌ	NO	NO	SÌ	SÌ	NO	NO	SÌ	SÌ	NO	NO	SÌ	SÌ	NO	NO	SÌ	SÌ
Montaggio fascetta	SÌ	SÌ	NO	NO	SÌ	SÌ	NO	NO	SÌ	SÌ	NO	NO	SÌ	SÌ	NO	NO	SÌ	SÌ	NO	NO	SÌ	SÌ	NO	NO

HighPure HPG

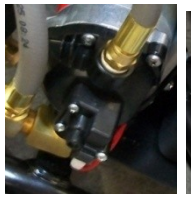
- Fluid-o-Tech rotative vane pump
- Endothermic motor Honda GX120 (4HP)



HighPure technical components

Safety and control

- Safety valve to protect the pump, in the electric HighPure model HPE, a by-pass valve which opens internal recirculation of the pump; in the battery model HPB, a manostat which disconnects power to the pump.




- Internal recirculation safety valve & constant flow drain valve, the first allows to recirculate part of the waste water flow from osmosis membrane to the pump, thus stabilising pressure inside the membrane and preventing damage; the second conveys the waste water from the osmosis membrane.

- Pressure gauge, constantly monitors water pressure in the osmosis membrane, preventing overpressure causing stress or damage to the membrane itself.

- Flow meter, measures the water circulating in the machine (water litres produced) ensuring that the filters are replaced at the right moment.

- Air vent valve, to vents air pressure in the osmosis membrane and for washing the membrane at the end of the work cycle.

- Non-return valve, prevents flow back of the pure water coming out of the membrane.

HighPure Technical components

Efficiency and saving

- Recirculation system, reduces water consumption by conveying part of the outflow water from the osmosis membrane to the pump (HPB,HPE and HPG model).

- Pure water outflow regulation valve, regulates the flow of pure water delivered by the machine to optimise water consumption according to the working situation.

- Y valve, to use two poles at the same time. Doubles cleaning efficiency.

Maintenance and filters storage

Maintenance

GreenTube

Daily maintenance

After using the machine, at the end of the day place it upright on a flat surface to drain all water left inside, thus washing the membrane of all salts and impurities. This operation helps extend the working life of the membrane.

Routine maintenance

•Replacing the sedimentation/active carbon filter and deionising resin cartridge (cod. KTRI40147).

- For both versions, every 2,500 gallons (10,000 litres) of water treated.
- For both versions, when the level of total dissolved salts (TDS) in the pure water produced exceeds 1-2% of the level of total dissolved salts (TDS) in the inflow water (measurable with the TDS hardness meter provided).

•Replacing the reverse osmosis membrane:

If both daily and routine maintenance are performed correctly as described above, the working life is estimated at about 3-5 years (with moderately hard inflow water).

Maintenance

HighPure

Daily maintenance

After using the machine, at the end of the day open the air vent valve to wash the membrane by draining the accumulated water rich in salts and impurities. This operation helps extend the working life.

Routine maintenance

•Replacing the sedimentation/active carbon filter and deionising resin cartridge (cod. KTRI40106):

- Every 5,000 gallons (19,000 litres) of water treated by the version without pump HP0 (the value can be read on the flow meter)
- Every 6,000 gallons (23,000 litres) of water treated by the versions with pump HPB, HPE and HPG (the value can be read on the flow meter)
- For both versions, when the level of total dissolved salts (TDS) in the pure water produced exceeds 1-2% of the level of total dissolved salts (TDS) in the inflow water (measurable with the TDS hardness meter provided).

•Replacing the reverse osmosis membrane:

If both daily and routine maintenance are performed correctly as described above, and if during each treatment the air pressure in the membrane is vented, the working life is estimated at about 3-5 years (with moderately hard inflow water).

Storage

GreenTube & HighPure

Short term storage: 2-4 weeks of inactivity

For both machines, empty the tube (in the case of the GreenTube) and filter containers (in the case of the HighPure), leaving the filters on the machine. See the Storage chapter in the relative instruction manuals.

Long term storage

For both machines, empty the tube (in the case of the GreenTube) and filter containers (in the case of the HighPure), putting only the sedimentation/active carbon filter back on the machine. Hermetically seal the osmosis membrane and deionising resin cartridge in plastic bags. See the Storage chapter in the relative instruction manuals.

In both cases, make sure the osmosis membrane and deionising resin cartridge do not dry out or freeze.

Guide to the appropriate choice of the IPC equipment

The choice of the IPC pure water generator

The most complete answer in the world of pure water

The main parameters guide for the choice of the correct machine are **frequency of use**, **height** and **power supply availability**:

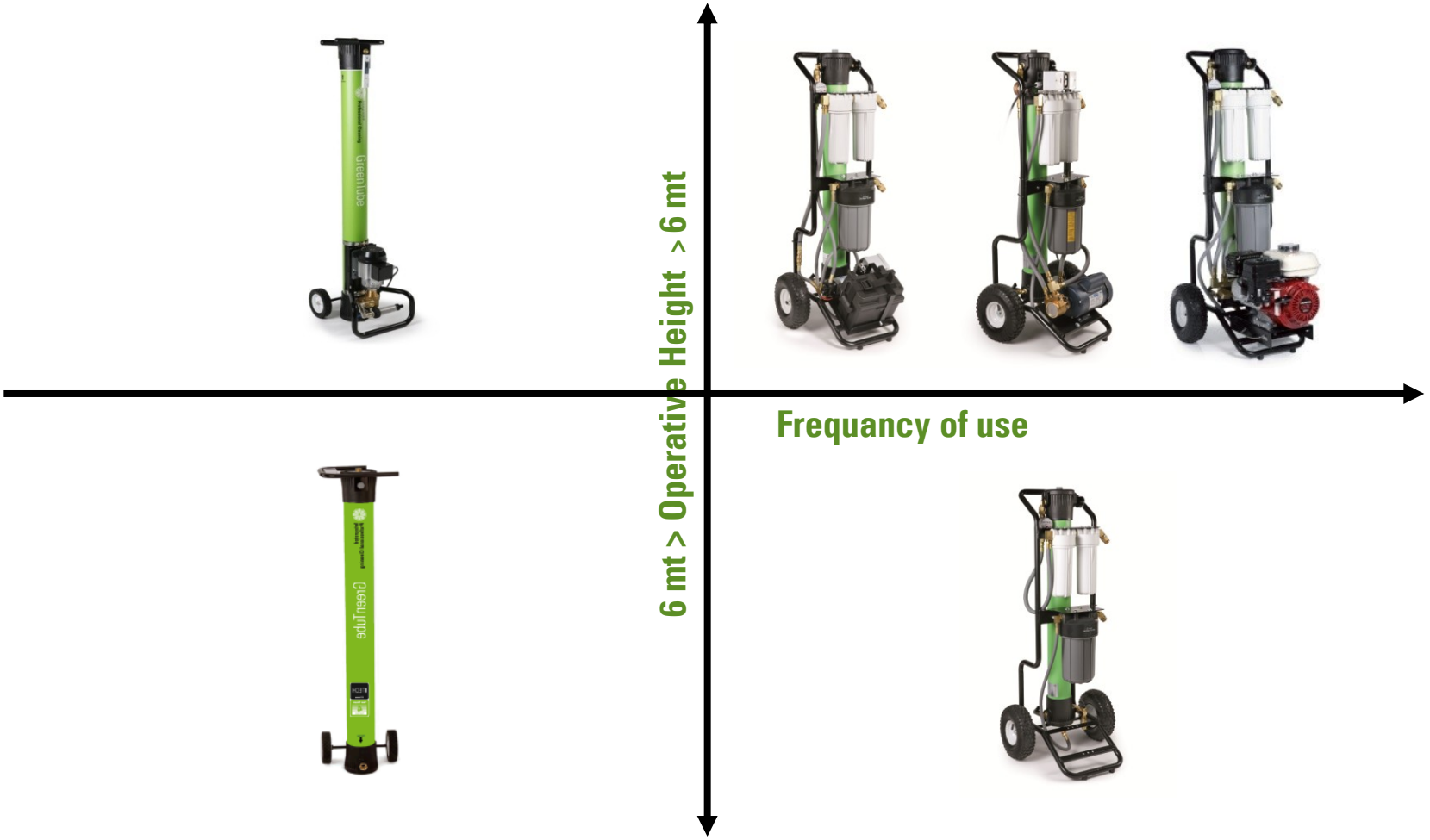
- **up to 6 meters** height, light duty, 1-2 hours a day, **GreenTube** (**GT0**); *
- **up to 15 meters** height, light duty, 1-2 hours a day, **GreenTube** (**GTE**); **
- **up to 6 meters** height, heavy duty, 1-2 hours a day, **HighPure** (**HP0**); *
- **up to 20 meters height**, one operator, electrical supply not available, **HighPure battery** (**HPB**); **
- **up to 20 meters height**, two operator, electrical supply available, **HighPure electric** (**HPE**); **
- **up to 20 meters height**, two operator, electrical supply indipendence, **HighPure gasoline** (**HPG**); **

* For models without motor the maximum reach is given by the pressure water supply and therefore is not requested the electrical power supply.

** For the models with motor the maximum reach depends from the obstacles on the site

IPC Pure Water Systems

Positioning Range



The choice of the IPC poles

The main parameter that guides the choice of the most suitable pole is the **operative height**:

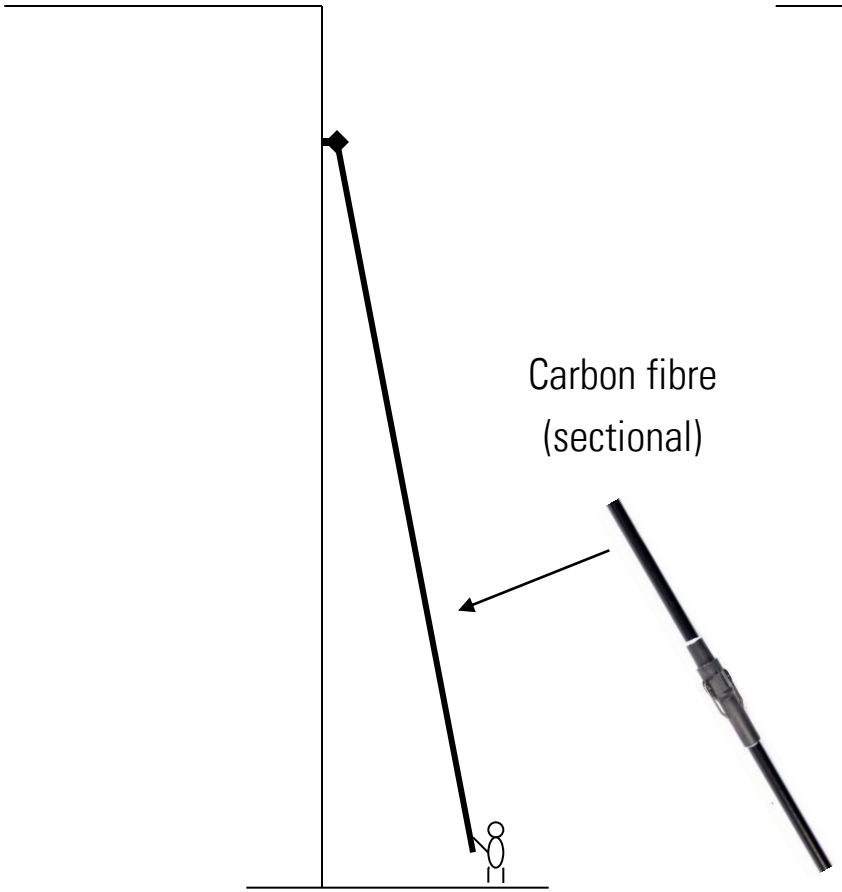
- **up to 6 meters** height, **telescopic pole in glass fibre** (**PGG07**);
- **up to 10,5 meters** height, **telescopic pole in glass and carbon fibre** (**PGC12**);
- **up to 13,5 meters** height, **telescopic pole in carbon fibre** (**PCC15**);
- **over 13,5 meters** height, **sectional pole in carbon fibre** (**QuickLock**); *

In case of **lower heights**, the recommended poles are those with less valuable materials, because even if the most weight, they have a lower cost, such as **glass fibre poles**.

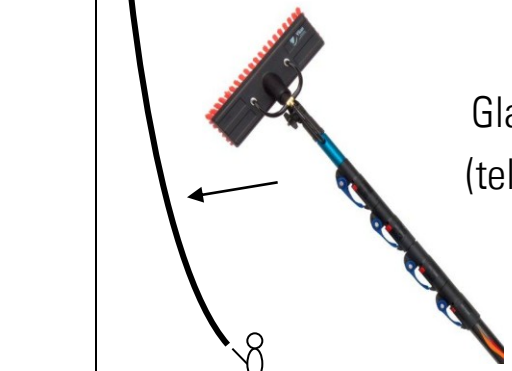
* The maximum operative height depends from the ability of the operator

The choice of the IPC poles

	Carbon fibre	Glass fibre
Lightness		
Stiffness		
Easy to use		
Cost		



Carbon fibre
(sectional)



Glass fibre
(telescopic)

Guide to the perfect windows cleaning through pure water

The traditional window cleaning and the coming of pure water systems through poles

Traditionally, window cleaning requires the use of ladders, platforms, scaffolding and other equipment of suspension in share of people.
The first companies specializing in window cleaning were born in England but after a few years, cleaning activities at high altitude were banned because of numerous accidents at the cleaners.

Then the figure of a professional window cleaner has been developed in the United States, where prominent was the need to reduce time and operational costs.
In both realities, were born regulations to protect workers and to limit the risk of falls, such as the **European Union's Work At Height Regulations**.

Recently, in countries where the window cleaning started, in particular United States and England, **professional operators have adopted the pure water cleaning systems** to speed up the cleaning activities and to improve the operators safety.

How to use equipment safely and effectively

To work safely

Once the operating area is defined as a function of the pole lenght we are going to use, the risks for the operator may result primarily from an improper use of poles system.

To avoid risks:

- refer to the laws and regulations on work safely.
- Consider the weather conditions with particular attention to the presence of wind which can interfere with the cleaning activities.
- Once activated the machine, to extend the pole vertically, keeping in contact with the vertical surface to be cleaned. Proceed with the first section and then with the other until you reach the desired height.

To reduce the fatigue:

- to reduce fatigue, especially working at heights, it is recommended in the management of the poles, to reduce the use of arms and to work with the body rocking back and forth, practicing this technique starting from lower heights.

- It is advisable to make regularly short breaks during which developing other activities.

To avoid straining your back:

- do not tilt to much of the poles.

- The pole in contact with the surface have to create a 20° angle, or maximum 30° angle.

To limit the risk of accidental fall:

- if the pole for any reason loses its center of gravity and begin the fall, the operator must immediately move towards the drop point, this facilitates the recovery of the pole position. Also these movements should be tested at lower heights before proceeding with the cleaning activities.

Always avoid the following behaviors:

- use of damaged poles;
- use of poles in presence of strong wind;
- use of poles near electric lines;
- use of poles during storms.

How to use equipment safely and effectively

Operational efficiency and speed of use

- Always check the quality of the produced water through the TDS water hardness meter and replace filters if necessary. Glass cleaning quality depends on the water quality.

- The most annoying phenomenon that can cause a stretching of the cleaning times is the presence of stains and residues. The most common elements that can cause stains and residues are:

  - ✓ very dirty frames and structures; in this case be sure to wash the frames and structures well before proceeding with the glass cleaning. If this step is not done, there is the risk that at the end of the cleaning, the dissolved dirt present in the edges of the structure, run down the glass.
  - ✓ Residues of detergent; the use of detergents can make difficult to rinse residues. For this reason IPC does not recommend detergents in general which make necessary to repeat the rinse in order to completely remove the residues of glass.
  - ✓ Poor quality of paint or excessive paint aging of metal frames or structures. For this factor, are available the considerations on the content “very dirty frames and structures”.
  - ✓ Very dirty glass; if you are doing a first initial clean and the glass hasn’t been cleaned in years, use the procedure described for cleaning very dirty frames and structures. Besides, keep in mind that the first glass cleaning takes two steps.

How to use equipment safely and effectively

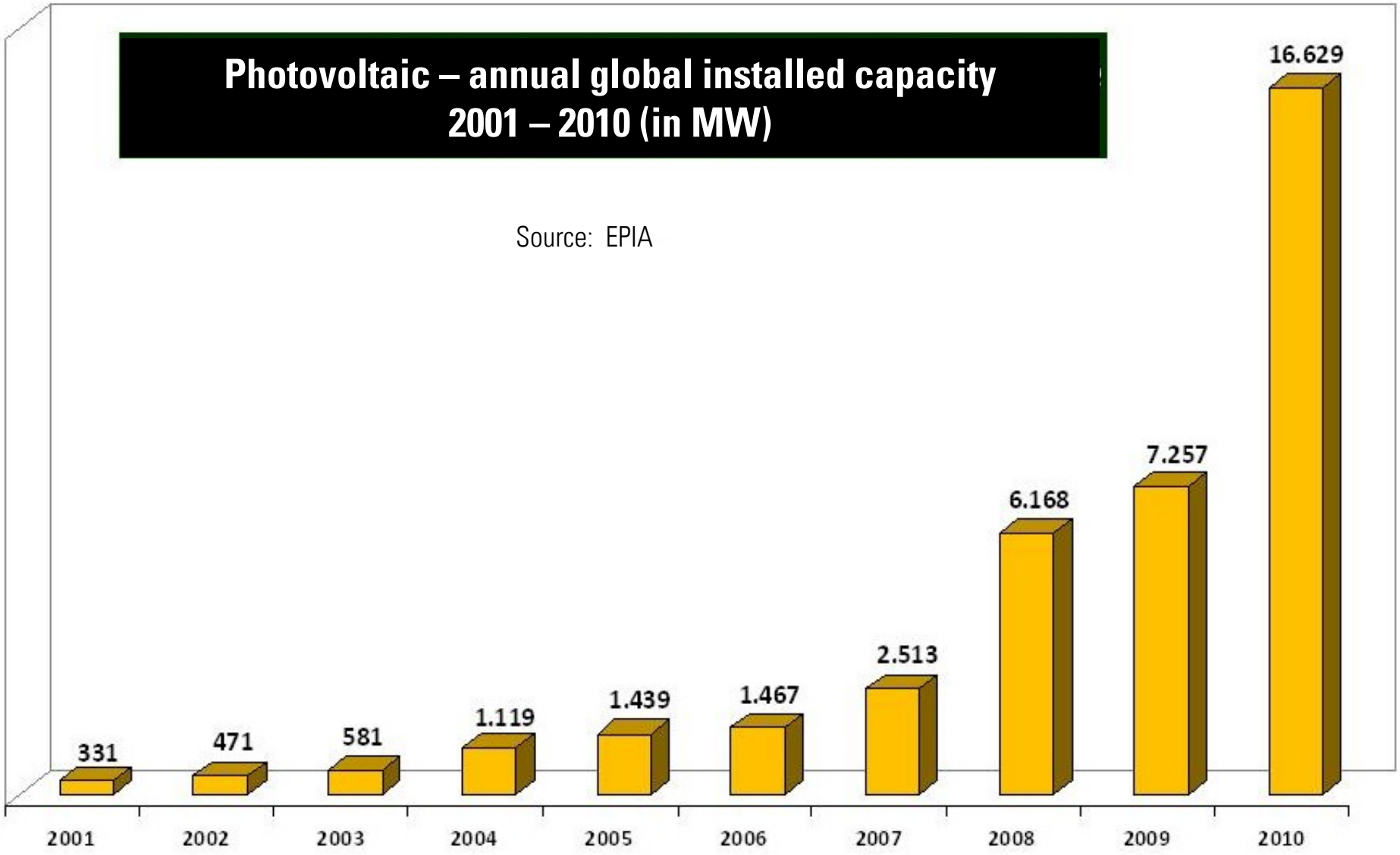
Operational efficiency and speed of use

- ✓ Dirty brush head; to avoid this problem, it is advisable to leave the brush soaking in pure water overnight or between jobs.
- ✓ Bird muck; the removal of this kind of dirt can be a problem, especially if the bird mucks are baked on the glass, under the sun and they are become persistent dirt. For this kind of dirt, is advisable to do the windows first, soaking the offending staff well till the water has softened it a bit, and using water and brush. If such measures were not enough, use the edge of the brush or an appropriate scraper.
- ✓ Alluminium frames; these can cause problems if the covering is ruined and the paint has oxidised. In the presence of these oxidation, offer the cleaning service may be inconvenient because the water is in contact with a whitish solution that is not easy to manage. If you want to proceed, carry out tests on delicate parts and, in agreement with the client, evaluate the cleaning to be carried out.
- ✓ Air vents; situated directly above the glass, these vents contain large amounts of dust and dirt. Avoid absolutely vents and air gratings. If water gets inside these vents, it will drip for ages leaving the cleaned glass with dirty streaks.
- ✓ Proper use of pure water flow; increasing the amount of dirt, the raising of the water flow will speed up the cleaning activities. Then use a sufficiently high water flow, saving it during free times preventing to water the garden during operational breaks.

The application of the IPC pure water systems for the cleaning of solar and photovoltaic panels

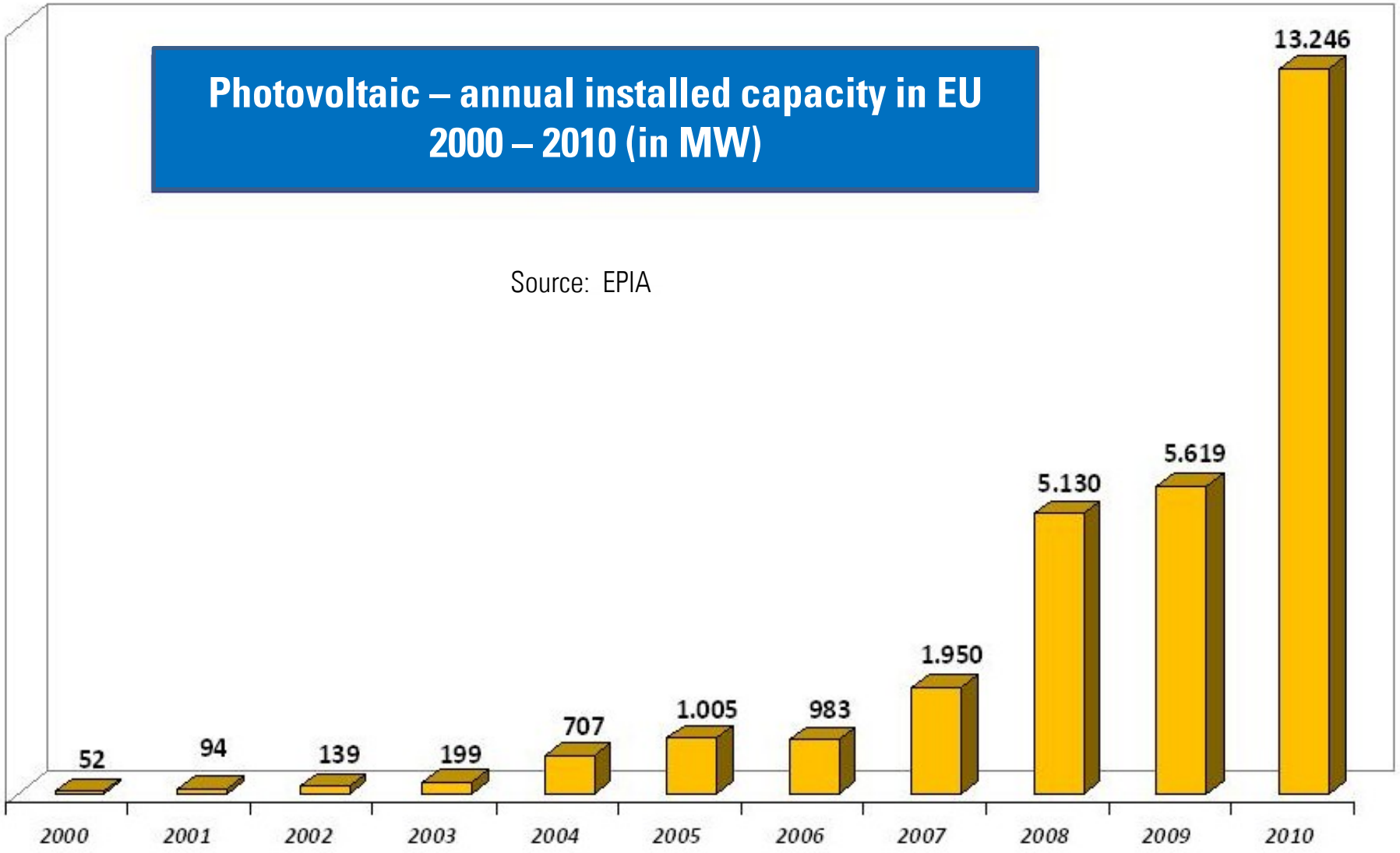
Photovoltaic – annual global installed capacity 2001 – 2010 (in MW)

Source: EPIA

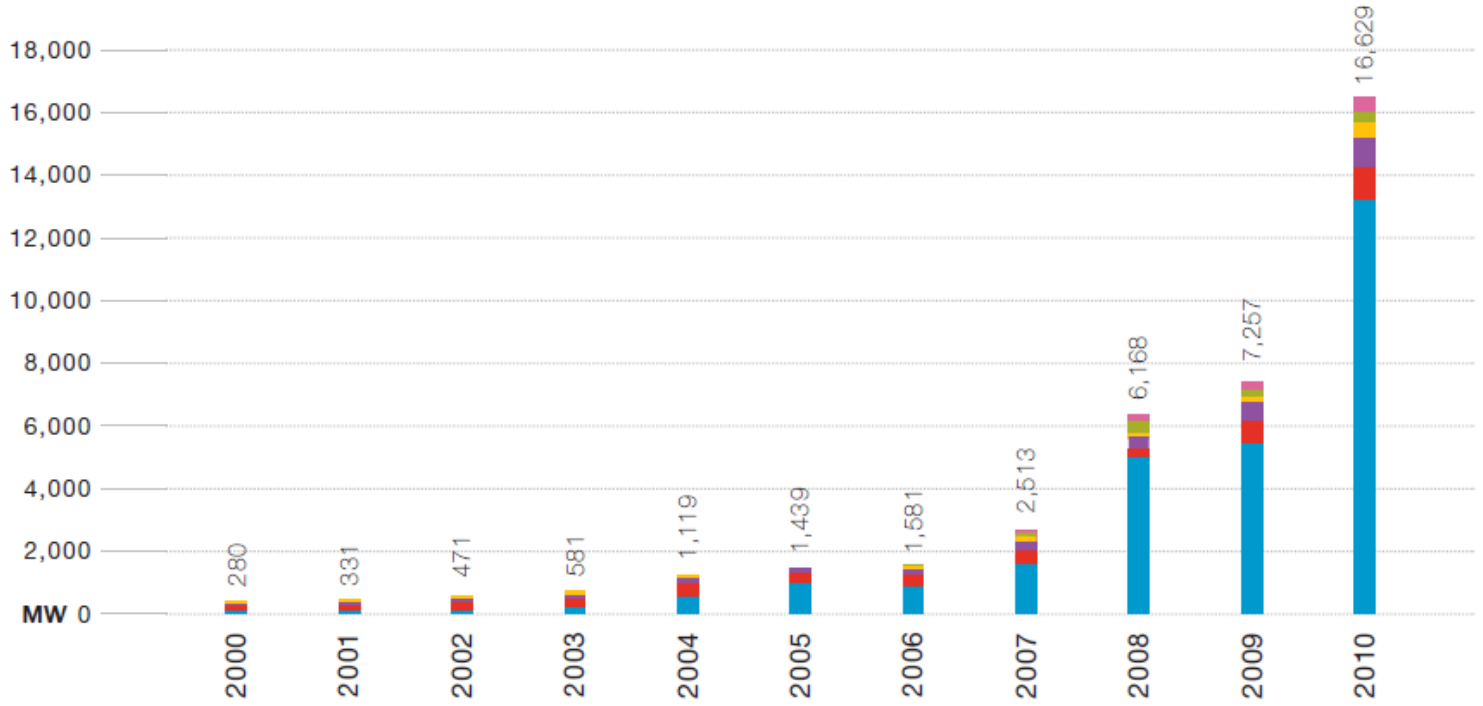


Photovoltaic – annual installed capacity in EU 2000 – 2010 (in MW)

Source: EPIA



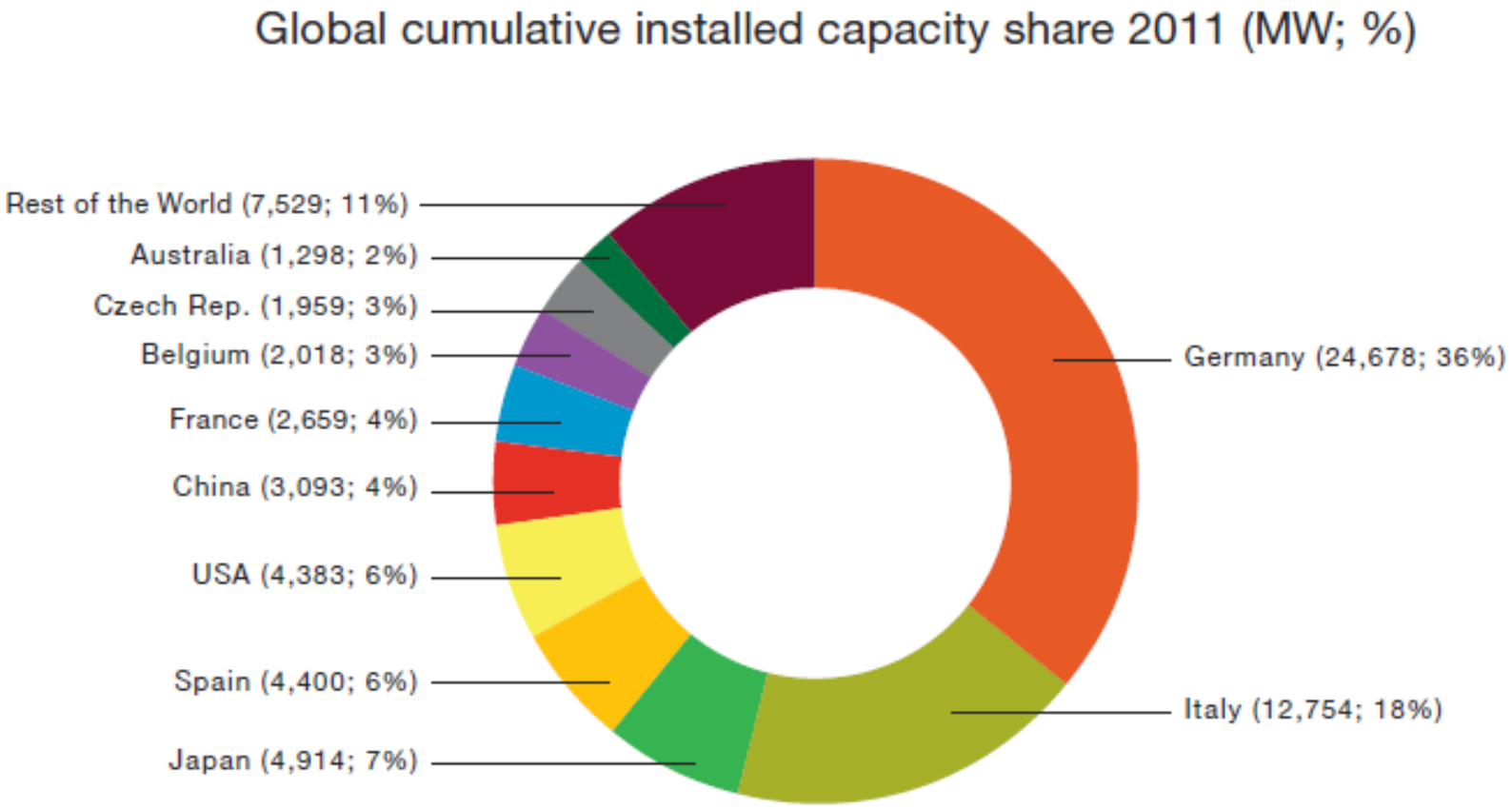
Evolution of global annual PV market, 2000-2010 (annual data, not cumulative)



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
China	0	11	15	10	9	4	12	20	45	228	520
APEC	5	5	7	8	10	13	33	59	300	258	473
Rest of the world	88	56	80	77	29	10	118	63	115	130	417
North America	23	31	46	65	92	117	149	212	349	539	983
Japan	112	135	185	223	272	290	287	210	230	483	990
EU	52	94	139	199	707	1,005	983	1,950	5,130	5,619	13,246
Total	**280**	**331**	**471**	**581**	**1,119**	**1,439**	**1,581**	**2,513**	**6,168**	**7,257**	**16,629**

Source: EPIA, Global Market Outlook for Photovoltaics until 2015

Fotovoltaic – global market figure



Fonte: EPIA, Global Market Outlook for Photovoltaics until 2016

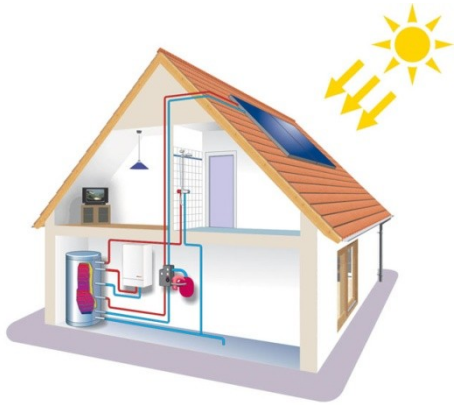
Cleaning and maintenance of solar and photovoltaic panels

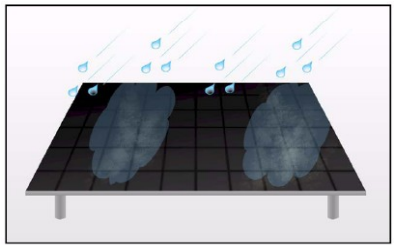
Why clean solar panels?

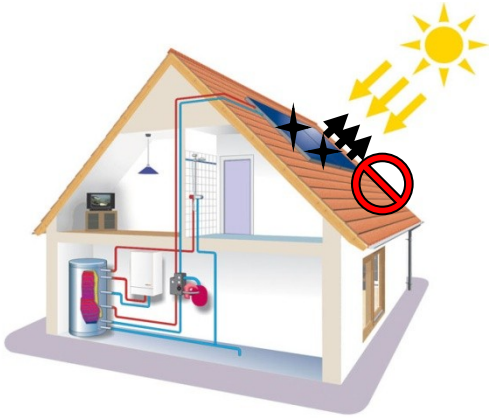
Photovoltaic panels are perennially exposed to various types of bad weather and are thus a **target for dirt**, dust and atmospheric pollution, algae, moss, bird lime etc.

The deterioration of the surfaces depends also from the chemicals released by detergents during cleaning activities.

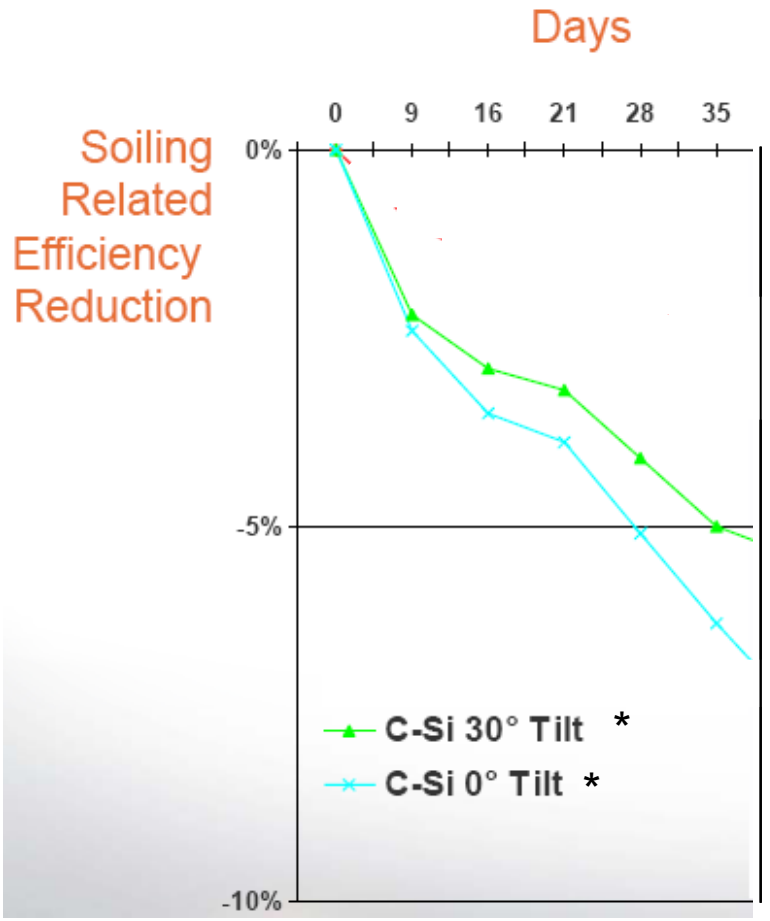
The presence of these elements on the panel's surface prevents the sun's rays from filtering onto the panel's photovoltaic cells completely, with negative repercussions on the appearance and the function of the structure, reducing the solar performance and therefore efficiency.







Research and data on solar panels show that the efficiency of panels not cleaned regularly can rapidly drop to 20-30% that of regularly cleaned panels.

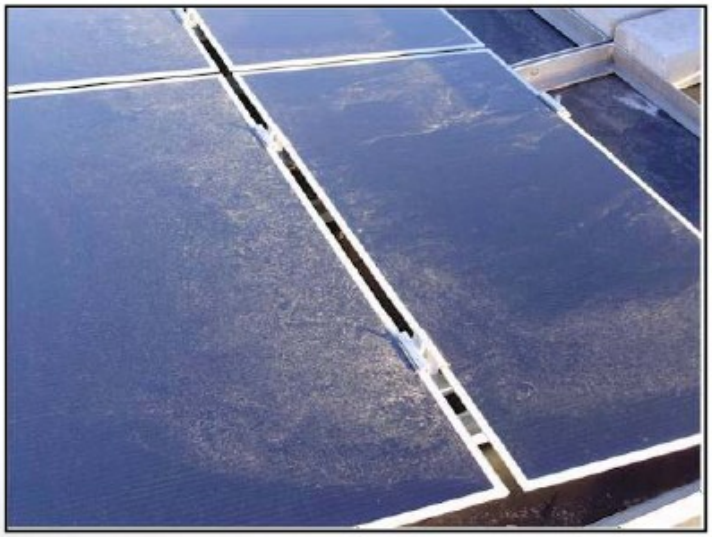


Factors which impact negatively on the panels:

- dirt
- rain
- chemicals released during cleaning activities

Location test:
Fremont, CA.

* Photovoltaic panels at 30% tilt vs. photovoltaic panels at 0° tilt.



Dirt at a glance:

- reduces the panels efficiency;
- causes material damages.

Cleaning is therefore **an indispensable part of the maintenance**.
The choice of the cleaning frequency depends on the place where the panel is installed.
Areas near industrial centres require more thorough maintenance than rural areas.

Current methods of panels cleaning and associated risks

- **Rain**, considered as a means of cleaning, but in fact with low efficiency. It may be aggressive as a result of pollution.
- If not carefully chosen, **chemical products** may be aggressive to the materials, reducing transparency.
  Chemical waste products may not be dispersed in the soil or drainage system and compliance with local environmental regulations incurs costs.

Manual cleaning, on the other hand, represents a risk for operators who often work at a height of 4-6 m from the ground, with a risk of falling.

SOLARE BUSINESS

CLEANING

Panels should be cleaned regularly following the information provided by the installer and supplier. The film which forms on the surface of the modules due to pollution and dust may cause productivity to drop by between 10 and 25%. In the majority of cases, if the panels are cleaned regularly to prevent layers of impurities from building up on the coating of the cells (usually made from glass or Tedlar), it is sufficient to wash with osmotic water (water purified using the reverse osmosis process). Use of mains water is not recommended, particularly in areas where the water is particularly rich in limescale and impurities. When washing, avoid the use of pressure instruments, solvents, particularly aggressive cleaning substances and household detergents.

(source: Solare Business No. 1/2 Jan-Feb 2012)

The IPC pure water solutions for the cleaning of photovoltaic panels

The operational flexibility of IPC's pure water systems makes them the most effective and complete systems on the market for cleaning numerous surfaces and materials, including solar and photovoltaic panels.
The HighPure system is:

- **safe and easy to use**, limiting the use of ladders or scaffolding. Together with the extensions and accessories, the poles can be used to reach roofs and all types of panel installation.
- **Quick and effective**, work times with the HighPure system are 75% less than with traditional methods.
- **Environmentally friendly**, perfect cleaning without using detergents. Thanks to the low water consumption and absence of all chemicals, the panels can be cleaned perfectly in full respect of the environment.
- **Low running costs**, thanks to the four-stage filtering system, the cost per litre of pure water produced is very low.

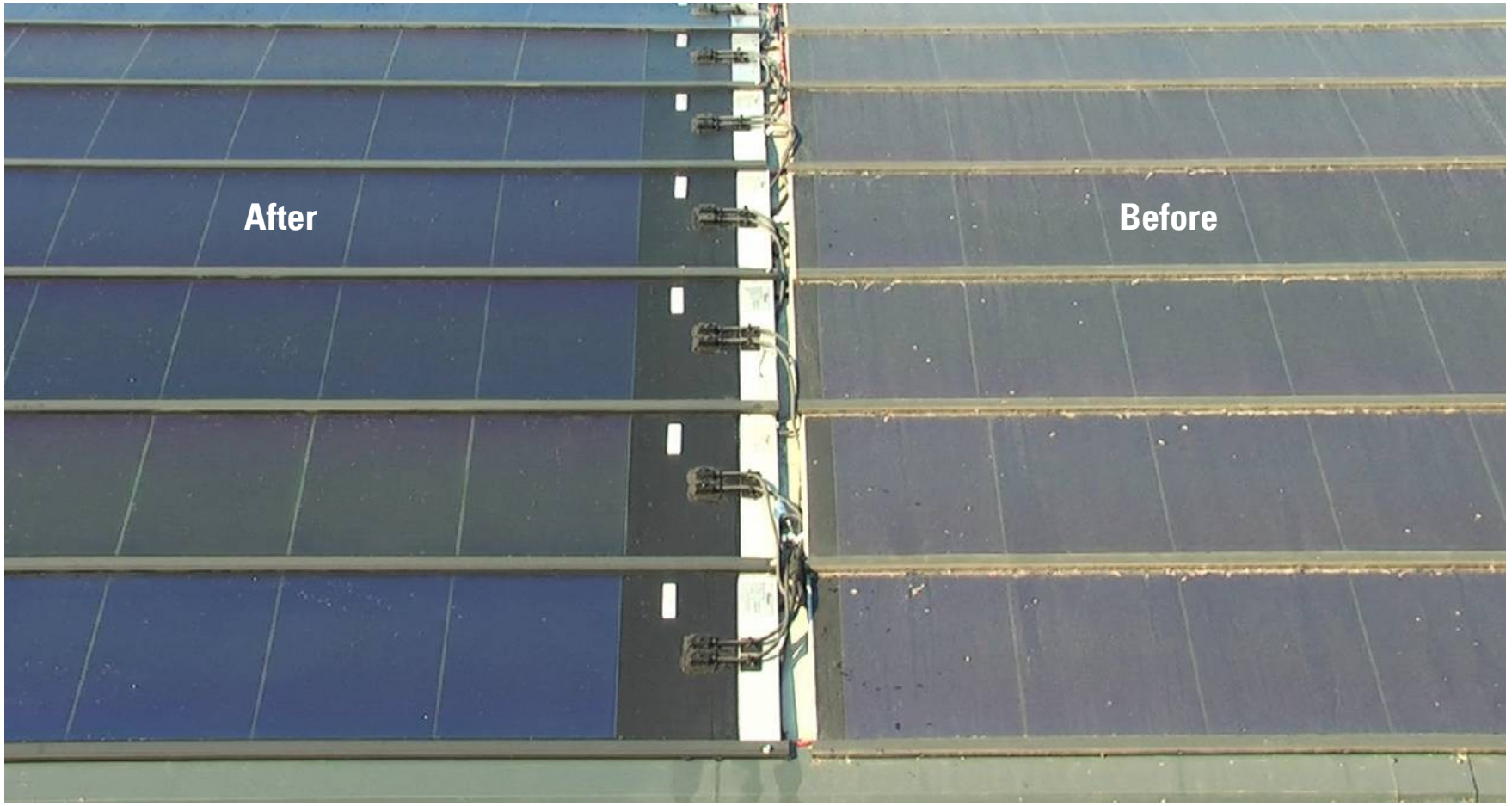
The IPC pure water solutions for the cleaning of photovoltaic panels

➢ Practical and versatile

Solar and photovoltaic panels are available in different types and may be installed in various ways, on the ground, on roofs or at great heights, sometimes without access to an electricity supply on the work site.

HighPure is the only battery and endothermic powered system with reverse osmosis and deionising.

Photovoltaic experience with IPC Pure Water



Photovoltaic panel (amorphous silicon on thin film technology)

Thank you for the attention!